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ABSTRACT

Chapter I of this manual for a planning simulation system for higher education presents some basic outlines to aid in the planning process, including the "outline of plans" as a concrete aid to systematic planning. This chapter also identifies some of the typical problems and barriers that hamper the planning process, and conveys the need for a structured planning approach. The second Chapter discusses simulation and modeling, and the third the modeling language. Basic elements of PLANTRAN are described in Chapter 4 and examples of model design are presented in Chapter 5. Chapter 6 discusses generating alternative plans with use of a System Driver, and Chapter 7 presents a summary. PLANTRAN exercises, a sample college model, and identification and description of error messages and common data errors comprise the appendices. (AF)

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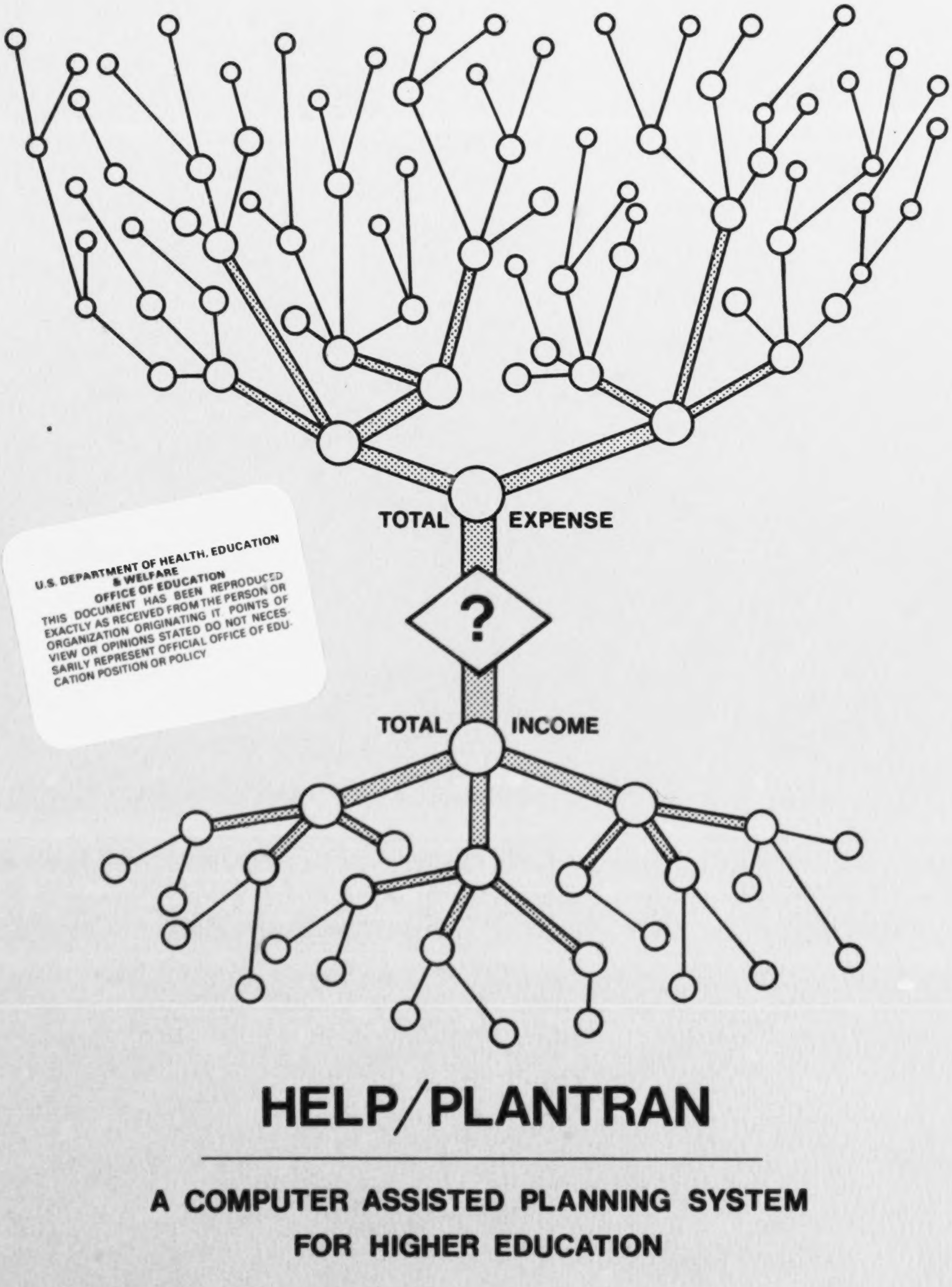

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HELP/PLANTRAN

A COMPUTER ASSISTED PLANNING SYSTEM FOR HIGHER EDUCATION

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HELP/PLANTRAN

A SIMULATION MODELING SYSTEM FOR PLANNING

Developed by

Economics and Management Science Division
Midwest Research Institute

1970

PREFACE

American technology seems to thrive on the solving of problems so long as these problems are of a purely physical nature. We can mass produce things in copious quantities. We can send men a quarter of a million miles through space and land them within several hundred yards of a pinpoint target on the moon. These are problems that largely yield to the laws of mathematics, physics, and chemistry. We seem not to be able to cope so well with problems that have a human element.

One of the magnificent tools our technology has given us is the electronic computer. Unfortunately, the prophecies of a "revolution in management" to be made possible by this new miracle machine have gradually led to adverse reaction and disillusionment.

It is our thesis that this disillusionment is not due to any lack of potential or lack of capability of the computer. Rather, it is a human shortcoming--a lack of capability in designing systems that simultaneously exploit the power of the computer and executive brain power. This shortcoming has been characterized by the application of computers to supplant rather than augment human capabilities.

Thus there has been an abysmal gap between the immense power of the electronic computer and some very real and difficult problems. The planning problem faced by upper level executives, particularly long-range planning, is one example.

There has been recent interest in the application of computers and simulation to planning. Early attempts to solve, or at least to work with, planning problems by using computer planning techniques have been criticized for a number of reasons, many of them valid. Some techniques were so simple as to be almost trivial, while others were so complex that they required too much technical expertise on the part of the users or a large staff of specialists.

The system presented in this manual is a completely new approach to planning. With this system, the people who are most affected by the results of the planning--the administrators, the executives, the faculty members--become the model builders and can take an active role in the planning effort.

The system requires no technical expertise--it uses a simple language that is almost exactly the same as the clerical instructions that some planners are using now in manual methods. This simple language is presented to a computer compiler, which then translates the information into computer terms. The information is processed by the computer, and the results are presented in a format set by the user. This system never requires the planner to know or to understand any of the technical aspects of computers.

This manual has been designed not only to provide the essential information on the uses of the computerized planning system but also to serve as a primer on planning. An appendix containing exercises makes the manual highly self-instructional. We believe that a person will understand the fundamentals of planning and be able to use the planning system after only a few hours of studying this manual.

The computerized planning system described in this manual can be used on nearly all computers. The only requirement is that the computer facility have FORTRAN and COBOL compilers and sufficient core memory. This system has been used on the IBM 360, Burroughs B5500, CDC 6400, and other computers, and is currently in use by a number of colleges and universities.

Richard L. Salmon, Duane Dieckman, and Jeanne Robertson of the Economics and Management Science Division of Midwest Research Institute, aided by William D. Sutterfield of Park College, were responsible for developing this system. Valerie Lee of MRI made major contributions to the preparation and editing of this manual.

Approved for:

MIDWEST RESEARCH INSTITUTE

John McKelvey
Vice President and Director
Economics and Management Science Division

December 31, 1970 (Second Edition)

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CHAPTER I

A SYSTEM FOR PLANNING

Planning is a decision-making process. It is a way for an organization or institution to meet expected change, produce desired change, and prevent undesired change. Today, more than ever before, educational institutions are subjected to increased pressures, demands, and constraints. If they are to survive and remain viable, they must be able to direct and control their own future.

The need for planning, then, is due to the changing environment, the complexity of operations, the ever-increasing requirements for funds, the increasing number and complexity of regulations, and the inadequacy of the old informal planning methods. It is no longer adequate nor wise to focus all the attention on immediate problems and let the future take care of itself.

Planning provides a systematic means for an organization or institution to develop a course of action to meet short-range and intermediate goals and needs as well as long-range goals and needs. In addition, the short-range needs--the problems at hand--can be satisfied within the framework of the long-range needs of the organization. An organization that has a carefully developed plan is in a position to anticipate and react positively to external events rather than to wait and be controlled. Finally, proper planning can give an organization a realistic understanding of its capabilities and resources and permit the organization to experiment with its resources to determine what must and can be done.

THE SYSTEM

The planning simulation system described in this manual is a powerful and useful tool to answer the characteristic "what if..." kinds of questions that frequently arise in formal planning. However, this system is no more than a powerful and useful tool. It must be used in a systematic way, within a structured context for developing alternatives--within a framework appropriate for policy and decision-making. The planning approach that is the setting for the simulation system is illustrated in Figure 1. This system consists of six basic steps, reinforced by analysis and review.

THE PLANNING APPROACH

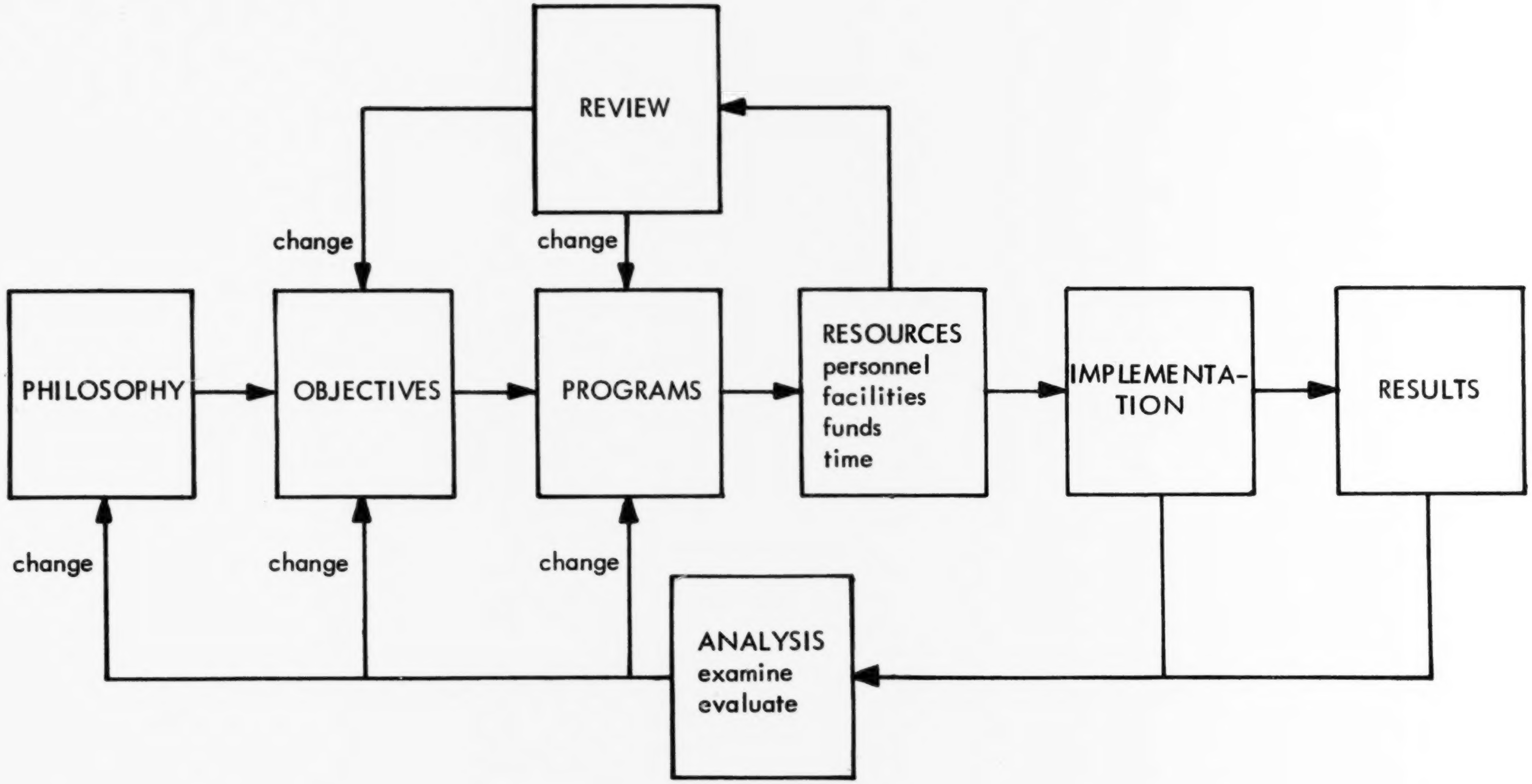

REVIEW
change
change
PHILOSOPHY
OBJECTIVES
PROGRAMS
RESOURCES
personnel
facilities
funds
time
IMPLEMENTA-
TION
RESULTS
change
change
change
ANALYSIS
examine
evaluate

Figure 1

The first and by far the most fundamental consideration in planning for any institution or organization is a careful examination of the philosophy of the organization--the why, the raison d'etre, the mission. All decisions, plans, and acts must be consistent with the institutional philosophy.

Objectives are the second consideration in planning and relate to determining where the institution is now and where it desires to be at various points in the future. Consideration of objectives also aids in establishing priorities--deciding what is of immediate concern and what may be deferred.

Programs, the next consideration, are the logical product of the establishment of objectives. Programs cover what must be done to achieve the objectives, and the planners must determine both how and when the programs will be applied.

The fourth consideration--resources--brings reality into the planning process. Resources of personnel, facilities, funds, and time must be examined and matched with what is needed for the programs. Most often, the natural outcome of this matching will be changes in the programs and, quite possibly, in the objectives. These changes in the plan represent a very important step, for they determine what will actually be placed into operation. These changes may require that priorities be altered and that programs be modified; most surely time schedules will shift. The end result of these changes, however, will be much better if a systematic approach has been followed.

The fifth consideration--implementation--concerns execution of the plan. Responsibilities are assigned and all needed resources are provided for incorporating the plan into the organization. Throughout the implementation phase, the plan is analyzed, and results are continually examined, for it is almost certain that at least some small changes must be made to enhance the actual operation of the plan.

The final consideration--results--concerns accomplishments under the plan. Measurement of the results permits the planner to observe what works and--what may be more important--what does not work. The major benefit from evaluation of results is the analysis of the overall performance of the plan.

The final analysis of the overall plan is converted into changes that feed back into the planning approach, giving future phases of the plan a higher probability of success. Thus, this process of continuous examination and evaluation enhances the operation of the organization.

It is in these inner "review" loops (shown in Figure 1) that the simulation tool can materially assist planners in evaluating, hypothesizing, and exercising alternatives.

This discussion has implied that planning is a rather straightforward, simple process. Quite often, however, planning attempts produce negative responses in those who should be involved. Some common responses from those who are approached about planning include: "We've survived without planning this long; who needs it?," "It's too blue sky," "It's just another job and I don't have the time," "It won't change anything," "It's inflexible," and "I know we're not doing as well as we can now, but if only they would...." These, and similar, responses have been heard by almost everyone who has attempted to initiate a planning function, and in some instances, the criticisms have been valid.

To counteract these criticisms and to provide a strong basis for planning, the plan must incorporate several elementary principles. First, the planning process must be simple enough to be understood by all those who should be involved with it. The plan must be selective in placing proper emphasis on various elements, and it must be adaptable and flexible enough to accommodate change. The payoff of the plan, or the final benefit to be derived, must be visible and worthwhile to all who are working with the plan. Finally, the planning process must not involve complicated, tedious paperwork to convert the desired goals into meaningful programs. The following section discusses a planning outline that is based on these principles and is an extremely useful tool in the planning task.

OUTLINE OF PLANS

Planning provides a systematic means for an organization to develop courses of action to satisfy its needs. A suggested form to be used in outlining plans is shown in Figure 2. This form, or a similar form, provides a systematic aid to thinking through the planning process, from the statement of the problem in specific terms and identification of measurable goals to the development of clearly expressed, step-by-step milestones that lead to the achievement of the goals.

The first column of this form contains space for an identification and description of the problem. This description should be as complete as possible because most problems are complex, containing many different elements. Each element should be specifically stated as a component of the problem.

Page ___ of ___ Pages

OUTLINE OF PLANS	☐ Worksheet ☐ Discussion Draft ☐ Proposed Draft ☐ Approved Plan	Name of Institution or Department			1. Urgent Need 2. Important Need 3. Moderate Need 4. Minimal Need	Index of Need
		Plan Date	Replaces Plan Of	Next Review Date		

Index of Diffi- culty	1. Not Difficult 2. Moderately Difficult 3. Highly Difficult 4. Very Highly Difficult									

Planning Subject	Problem Statement	Long Range Program Goals	Plan Of Action	Resource Identification And Development Plans	▽	▽	Composite Priority	Organizations Concerned With Planning, Decisions and Action	Five Year Program Objectives And Milestones By Years

Figure 2

The problem statement, in the second column, should be in quantified terms insofar as possible. Simply describing the subject further is not adequate. The problem implied in each element identified in the first column should be precisely set forth.

The next column provides space for a statement of the long-range goals for each facet of the planning subject. A specific period should be identified--10 years, 5 years, 3 years--and precise goals should be given in measurable, concrete terms. The goals must be defined to a degree that everyone involved understands fully what is to be accomplished.

The fourth column, entitled Plan of Action, concerns approaches and strategies. How is each goal to be accomplished? What methods are most appropriate, most feasible, and most promising? Consideration of these types of questions will provide the answers as to how the planning is to proceed.

In nearly all planning situations, there are other individuals, organizations, and agencies that have experience with the subject under consideration. They can assist in planning, identifying other resources, and refining strategies. These groups or individuals should be listed in the fifth column--Resource Identification and Development Plans.

The next column has space for listing other organizations with experience and responsibility for action in the problem area under scrutiny These organizations are frequently in a position to share in decision-making, implementation, and action. Participation by the members of these organizations will create in them a desire for the successful accomplishment of the objectives and will increase their willingness to cooperate.

The last column on the planning form, entitled Objectives and Milestones by Years, calls for a list of logical, feasible yearly objectives that grow out of the preceding columns and lead to the accomplishment of the long-range goals. The objectives reflect the progress from where the organization is now to where it wants to be. The objectives should be stated in quantifiable terms so that they can provide a yardstick for measuring progress toward the goals.

Of course, problems will occur in this planning approach. Probably the most frequently encountered problem will be delay. It seems that there is always someone or something that is not quite ready. Since the planning function seldom produces immediate results, other activities often seem to have higher priorities than planning activities. The importance of the planning must be constantly emphasized to keep the effort from becoming bogged down and forgotten among day-to-day activities.

Other barriers to the planning process include lack of top-level support and participation; trying to do too much, too quickly; not allowing time for those involved in the planning to learn about and understand the planning process; and over-emphasizing a specific portion of the planning task, such as long-range goals, data gathering, or some technical aspect.

THE DATA PROBLEM

Probably one of the most common arguments given against any type of quantitative planning is the lack of valid data. While the data requirements for the planning models considered in this system are not extensive, the facts are that most institutions find that they do not have even those data readily available. The argument then is: "Why plan when we don't have valid data?"

The answer is obvious. Some kind of structured approach to planning is mandatory. Systematic planning with scant data is preferable to no planning. Doing nothing is the worst possible type of planning. With planning, an institution can control its own course; without planning, the institution will be like a rudderless ship, controlled largely by external forces.

In developing models for planning, a fundamental question is: "Which comes first, the model or the data?" Obviously, it is neither feasible nor even necessary to collect every conceivable item of data that might at some time bear on institutional planning. The usefulness of a planning model lies in the fact that the critical data can be pinpointed and priorities can be set for data collection and information systems efforts. In gathering data, the rule should be: important data first, nice-to-know data later.

This chapter has presented some basic guidelines to aid in the planning process, including the "outline of plans" as a concrete aid to systematic planning. This chapter has also identified some of the typical problems and barriers that hamper the planning process. Most importantly, this discussion has tried to convey the need for a structured planning approach. These considerations are the most crucial aspects of the planning process. Yet the sheer drudgery of assembling, processing, and analyzing large quantities of data frequently reduces the effectiveness and usefulness of individuals engaged in the planning process. The following chapters offer a means of lessening the drudgery and enhancing the effectiveness of the planning function.

CHAPTER II

SIMULATION AND MODELING

With the development of the electronic computer, a new technique, simulation, has evolved as a practical aid to planning. This technique employs logic and mathematics in the construction of a computer simulation model that represents an organization's functions.

The term "model" may be defined as a representation of an object or a system, which is designed to look like or act like the real thing. There are several types of models. The type most everyone is familiar with is a physical model. This type of model looks like the item being modeled. Model airplanes, cars, trains, and the like are examples of physical models.

Another type of model most people are familiar with is a schematic model. These models are representations in pictorial form. They are abstract and their components (lines, symbols, arrows) are not found in the items they represent. Some examples of schematic models are blueprints, flow diagrams, organization tables, and wiring or electronic circuit diagrams.

A third type of model is a mathematical model. This model consists of a set of equations. The solution to the equations explains or predicts effects of changes. These models are an analytical effort to abstract and describe the real world. They are general, subject to manipulation, and precise in terms of the information gained from their use. These models may use basic mathematical operations--multiplication, division, and so forth--or more sophisticated mathematical formulae--regression analysis, correlation analysis, and the like.

The last type of model is the one we are most concerned with--a computer simulation model. A computer simulation model is simply a mathematical model that is expressed or written according to a particular set of rules, so that the model may be processed by a computer.

For planning purposes, the computer model will portray real or expected conditions in the operation of an organization. The representation will be based upon the planner's experience and observation of how the organization functions through time. The model will be constructed by assigning quantitative values and relationships to the elements, or planning items, that characterize the organization.

We mentioned above that simulation is dependent upon a computer model to represent an organization's functions. Simulation is basically a technique for conducting experiments. It can be used to study problems where rules, policies, procedures, and other controlling aspects are under question and in which the number of variables and the uncertain nature of input make the problem difficult to analyze by conventional techniques. The products of simulation models are solutions to problems. Also, these experiments at problem solving provide a method of determining cause-and-effect relationships without actually experimenting with the organization.

A simulation model that accurately reflects the complex and dynamic interrelationships of organizational elements has several substantial advantages. The simulation model can:

- Stimulate the imagination and improve perspectives.
- Assist in designing, manipulating, and examining various alternatives.
- Facilitate communication among the people involved in planning and policy making by presenting a physical point of reference.
- Clarify and examine issues and focus effort on the major ones.
- Teach the planners and policy-makers how to plan better by permitting insight into patterns of crisis.
- Develop contingency plans and anticipate crises with planned action.
- Create methodologies, procedures, and frameworks for problem solving.

The answers that the experiments can provide permit sound policy decisions to be made with relative ease. As changes are noted, they can readily be incorporated into the model, keeping it viable and accurate in representing the organization.

This simulation system represents a unique approach. The approach itself is not a model but simply a system that planners can use to develop models. One important contribution to planning success is the capability to assess a large number of alternatives rapidly and accurately. This approach is designed to do precisely that.

The concept underlying the system is similar in some respects to that of a conventional mathematical model that has been used by planners for years: the budget. (See Figure 3.) The computer planning model uses some of the same line items and adds to them other items--number of students, number of faculty, and so forth. (See Figure 4.) When the various elements of this model are projected into future years, the model simulates organizational behavior.

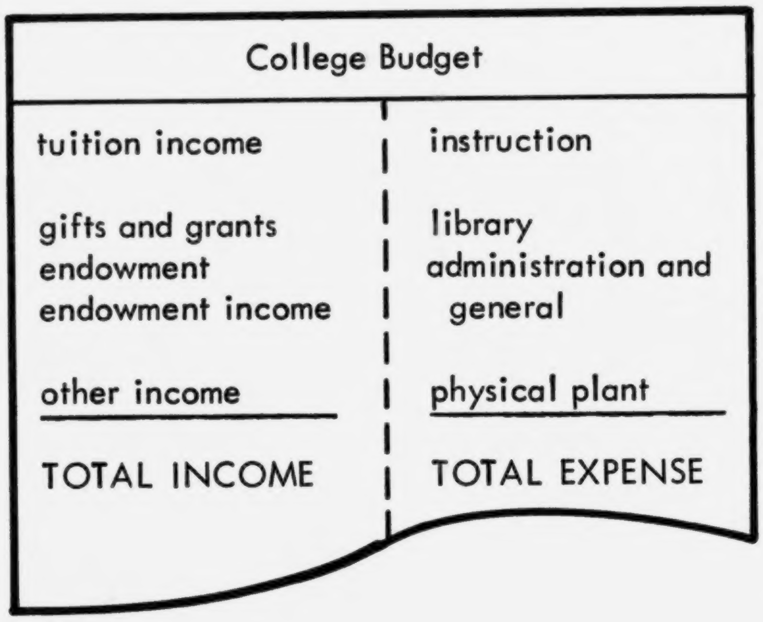
The following example illustrates the kind of situation in which computer simulation can be extremely helpful in quantifying and projecting the effects of change. In this example, the basic problem that the simulation model can be used to solve is: What will be the impact on student financial aid needs if a college increases its tuition and fees?

A small liberal arts college has forecasted a need to increase its tuition and fees by $600 over the next 5 years. This increase, of course, will provide the college with more income, but it will also affect other parts of the college's operation--particularly student financial aid. The most obvious effect is that additional funds will be needed simply to enable the percentage of students who are now receiving aid to meet the increased tuition and fees.

At present, 20 percent of the students receive some form of financial aid. As the tuition increases, however, it is quite likely that a greater proportion of students will be unable to pay the tuition and fees in full, so that a greater percentage of students will need financial aid. Simply stated, not only will the amount of aid for each student increase; the number of students needing aid will also increase. One result is that additional funds will have to be obtained from federal and other sources. Another result, however, may be that the size and the structure of the student financial aid office will have to be changed. For instance, if the percentage of students needing aid increases from 20 percent to 25 percent, more personnel may be needed to administer the student aid program. After all, for the student aid office the percentage increase in total number of students needing aid is not 5 percent but 25 percent. If additional personnel are needed, they may need more office space, and the financial aid operation itself will require additional funds for salaries, equipment, and expenses.

This simplified example shows how easily one apparently straightforward decision can quickly lead to a variety of other changes. It is in these kinds of rapidly pyramiding, cause-and-effect events that a computer simulation model can be most helpful. If appropriate information and data have been incorporated into the model (such as percentage of students needing aid, average amount of aid given, number of students served per professional employee), the computer can combine these figures with other

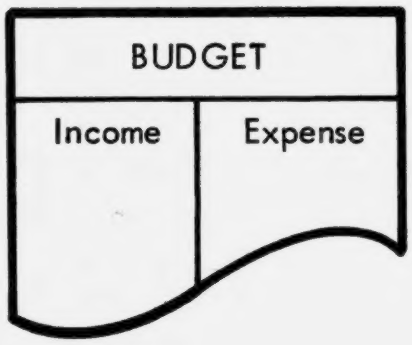
COMMON MATHEMATICAL MODEL IN COLLEGES



College Budget	
tuition income	instruction
gifts and grants endowment endowment income	library administration and general
other income	physical plant
TOTAL INCOME	TOTAL EXPENSE

Figure 2

INSTITUTIONAL MODEL BASED ON BUDGET STRUCTURE



- number of students
- tuition
- alumni
- friends
- corporations
- special activities
- investment portfolio
- foundations and government

- faculty and staff
- departmental expenses
- publications
- travel
- classrooms
- square feet
- library volumes
- maintenance costs

Figure 3

figures on projected enrollment, future tuition, and other relevant factors and calculate the additional aid money and operating expenses at various points in the future. The computer will also incorporate these figures into the more general areas of the model, such as total income and total salary expense.

Such a computer simulation model can free administrators and planners from innumerable time-consuming and tedious calculations to determine the effects of various changes. In addition, the computer can effortlessly and accurately combine the thousands of bits of data that one change is likely to effect and produce an overall picture.

CHAPTER III

THE MODELING LANGUAGE

The projections and interrelationships of planning items are handled by a simple planning language with a small vocabulary based largely on standard English. The language is called PLANTRAN, which stands for PLANning TRANslator. PLANTRAN is the basis of the planning simulator system.

In the discussion below, the term "variable" is used. Within this context variable has a special meaning. A variable is composed of a base value plus 10 period values, one value for each period of the planning horizon. The term variable is used to designate all the constituents of one line, or planning item, of the planning matrix. There are no fixed independent variables in the system. Variables that are independent in one model may be dependent in another. In some cases, a planner may insert a constant value line, or planning item. For our purposes, we shall call that line a variable also. Thus, all variables are specified by instructions in the PLANTRAN language.

THE PLANNING MATRIX

It may be useful to think of the planning vehicle as a matrix. Each row represents the projection of a planning item (variable) over a 10-period planning horizon. These projections may be simple extensions of a current or base value of an item, such as current AVERAGE SALARY projected with a 5-percent appreciation over a 10-year period. These are independent variables. Projections may also be functions of other planning items. For example, TOTAL SALARY EXPENSE might be derived and projected by multiplying AVERAGE SALARY by TOTAL STAFF. This type of projection is a dependent variable. It is the process of specifying each of these variables and determining how they are to be projected and how they are related to other variables that constitutes model building. The ease and simplicity of specifying each of the planning items belies the extreme complexity that the completed model may represent. The relatively simple static model is made complex by dynamic changes in planning items over time and even by dynamic changes in relationships among items.

Planners can use PLANTRAN to deal with individual planning items with ease and simplicity. At the same time, they may combine these items in an almost endless variety of ways to build a model of any desired complexity.

INDEPENDENT VARIABLES

Independent variables can be projected in one of four ways. These four methods are the most compatible with manual planning techniques:

1. CHANGE BY PERCENTAGE

   A variable may be changed (either increased or decreased) by a specified percentage each period. This projection is useful for handling variables that historically change by percentages. Example: Salary; increase 5 percent per year.

2. CHANGE BY AN INCREMENTAL VALUE

   The variable may be changed by a specified, fixed incremental amount each period. Often an item such as number of personnel is projected in this manner. Example: Research Assistants; increase 2 per year.

3. CHANGE TO A GOAL VALUE

   The variable may be changed to a specified goal value in a specified number of planning periods. This technique is useful both in determing and in evaluating goal-setting alternatives. Example: Fees; decrease to $50 in 4 years.

4. INSERT DATA

   The variable values may be known or follow a particular pattern. Any or all of the planning period values may be specified by the planner. This technique permits the constant value insertion mentioned above. Example: Reduction of indebtedness; 100000,0,0,10000,0,0,10000,...

DEPENDENT VARIABLES

The instructions provided for handling dependent variables are the basis of the power of the planning system. These dependent variable relationships may be designated in any one of five ways:

1. SUMMARY

The variable may be a simple summary of other uses. This technique permits totals, sub-totals, sub-sub-totals, and the like to be pyramided infinitely. Any number of other variables may enter into a summary variable.

2. FUNCTION OF OTHER VARIABLES

The variable may be a planner-specified function of other variables. This powerful technique permits the use of up to four variables, plus constant values, in combinations of addition, subtraction, multiplication, and division.

3. MAXIMUM OR MINIMUM OF OTHER VARIABLES

The variable may be the maximum (or minimum) of up to four other variables, period by period, across the planning horizon. This technique permits limits to be assigned to appropriate variables.

4. ACCUMULATION

The variable may be the accumulative summation of some other variable, period by period, across the planning horizon. This technique permits expenses, for example, to be accumulated through the planning periods. An option within this technique allows the variable to be the accumulative product of some other variables.

5. SHIFT ONE PERIOD

The variable may be a combination of a constant value times the value of another variable in the last period. This technique permits the shifting of a variable, or a constant value times the variable, one period along the planning horizon. The method can also be used as the basis for differentiating a variable over time.

HEADINGS

The final instruction in the PLANTRAN language permits headings to be inserted in order to organize and identify the various parts of the final computer print-out. In addition to identifying subdivisions, this capability also provides space for explanatory comments.

The instructions on independent variables, dependent variables, and headings may be used by the planner in an almost unlimited fashion. A variable may be built up by intermediate calculations and combinations of the instructions to produce functions of any desired complexity. By imaginative use of the modeling language, the planner is able to construct a wide variety of models.

PLANTRAN has been designed so that any planner, from the novice to the experienced professional, can use it easily and profitably at his own level. PLANTRAN is useful for the beginning planner; it is powerful for the experienced one.

CHAPTER IV

BASIC ELEMENTS OF PLANTRAN

In PLANTRAN, as in most other programming languages, the length of an individual instruction or statement is limited by the number of columns on a single punched card. If a statement exceeds the limit of one card (80 columns), a notation must be made to indicate that the statement is continued on the following card. In addition, certain characters have specific meanings and therefore are "reserved" in their use within a type of instruction. Three basic types of information can be entered into the model with the PLANTRAN language: identification input, instruction input, and summary report input.

IDENTIFICATION INPUT

The identification input is the simplest of the three. The purpose of this input is to identify the various parts of the plan. A sample of the plan identification sheet that is used for the identification input is shown in Figure 5. The sheet consists of five fields (the sixth field on the right side of the sheet is not used), each with a certain number of columns. The five fields and the data to be placed in each are:

Field 1--Columns 1-24, INSTITUTION. Contains the name of the institution.

Field 2--Columns 25-40, DATE. Contains the date of the plan.

Field 3--Columns 41-56, DESCRIPTION. Contains supplementary information.

Field 4--Columns 57-60, BASE YEAR. Contains the base year number.

Field 5--Columns 61-63, PLAN. Contains an identifying number of the plan.

The information that is entered on this sheet will provide headings to identify the plan and specific parts of the plan. In addition, the base year field provides the year, or period value, from which the planning horizon is identified. For example, if 1970 is inserted in the base year field, the planning horizon will reflect yearly values for the next 10 years: 1971, 1972, 1973...1980. If a time period other than a four-character year is desired, the value must be "right adjusted"; that is, it must be entered

MRI

PLAN IDENTIFICATION DATA SHEET

Name ____________________

Project ____________

5 10 15 20 25 30 35 45 50 55 60 65 70 75 80

INSTITUTION 1 24	DATE 25 40	DESCRIPTION 41 56	BASE YEAR 57 60	PLAN 61 63	

Figure 5

in the rightmost columns in the base year field. A unit of 1 is added for each period of the planning horizon.

INSTRUCTION INPUT

The second type of input involves the instructions to be used in the actual construction of the planning model. There are 10 different types of instructions and all use the format shown in Figure 6.

The instruction input format is divided into seven sub-sections, or data fields. The number of columns in each field varies, although all 80 columns are used.

Six of the data fields are basically the same, regardless of the type of variable, or planning item, that is being specified. The data fields, the numbers of the columns in each, and the type of data to be entered in each are:

Field 1--Columns 1-3, LINE NUMBER (required). This field contains the line number associated with the planning item.

Field 2--Column 4, CHANGE IDENTIFICATION (optional). This field contains a number to identify a change associated within a planning item.

Field 3--Columns 5-32, PLANNING ITEM (optional). This field contains a description of the contents of the variable.

Field 4--Columns 33-40, BASE LEVEL (optional). This field contains the value for the base year or time period for the variable.

Field 5--Column 41, CODE (required). This field contains a code to indicate the technique to be followed to calculate the variable.

Field 7--Columns 78-80, SUM (optional). This field contains the line number of the variable to which variables on this line are summed.

The remaining field (Field 6) is the method field, or FREEFORM METHOD OF COMPUTATION. This field, in many respects, is at the heart of the system, because it is in this field that the planner specifies how the variable is to be projected. The following three sections discuss the instructions for projecting the three types of information: independent variables, dependent variables, and headings.

INSTRUCTION DATA SHEET

MRI

Name ____________________

Project ____________

5 10 15 20 25 30 35 45 50 55 60 65 70 75 80

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1 3	4	5 32	33 40	41	42 77	78

Figure 6

Independent Variables

As noted in the previous chapter, there are four basic techniques for projecting independent variables: change by a percentage, change by an incremental amount, change to a goal value in a specified number of periods, and insert constant values into planning periods.

Change by a percentage. To change the variable by a specified percentage each period, a value must be present in the BASE LEVEL field, and the CODE field must contain a "2." Depending upon the degree of model documentation desired, the planner may use any one of a variety of terms in the METHOD field to generate the projection. For example, any of the following terms* would increase the base level by 6 percent per period:

CODE 41	FREEFORM METHOD OF COMPUTATION 42 … 45 … 50 … 55 … 60 … 65 … 70 … 75 … 77	SUM 78 … 80
2	CHANGE BY 6% PER PERIOD	
2	INCREASE BY +6.0 PERCENT PER PERIOD	
2	INCR 6.0%/PR	
2	I,6	
2	6	

To specify a 6 percent reduction from the base level, any of the following may be used:

CODE 41	FREEFORM METHOD OF COMPUTATION 42 … 45 … 50 … 55 … 60 … 65 … 70 … 75 … 77	SUM 78 … 80
2	CHANGE BY - 6% PER PERIOD	
2	DECREASE 6 PERCENT PER PERIOD	
2	DECR 6.0%/PR	
2	INCREASE -6 %/PERIOD	
2	D,6	
2	-6	

---

* The PLANTRAN language is designed to adapt to an increasing level of competence of users. Thus, as modelers become more proficient they may wish to eliminate some of the verbosity, writing instructions in a more cryptic, yet shorter, format. The examples shown on this and following pages each demonstrate the capability to increasingly shorten the instructions. The consequence--an increasingly cryptic instruction--is also demonstrated.

Note that this instruction produces a compounded percentage change--the value of each period is the given percentage above (or below) the value of the previous period. If the code "2" is used, and the METHOD field is left blank, zero percent is assumed, and the value for the base level will be inserted in each period of the planning horizon. The character "D," standing for decrease, is reserved, and should not be used unless a decrease is desired.

Change by an incremental amount. The second instruction changes the variable by a specified, fixed amount. This type of projection also requires a value in the BASE LEVEL field. The numeral "3" must be present in the CODE field. The examples below show the variety of terms the planner may use to increase the base level to be increased by 150 per period:

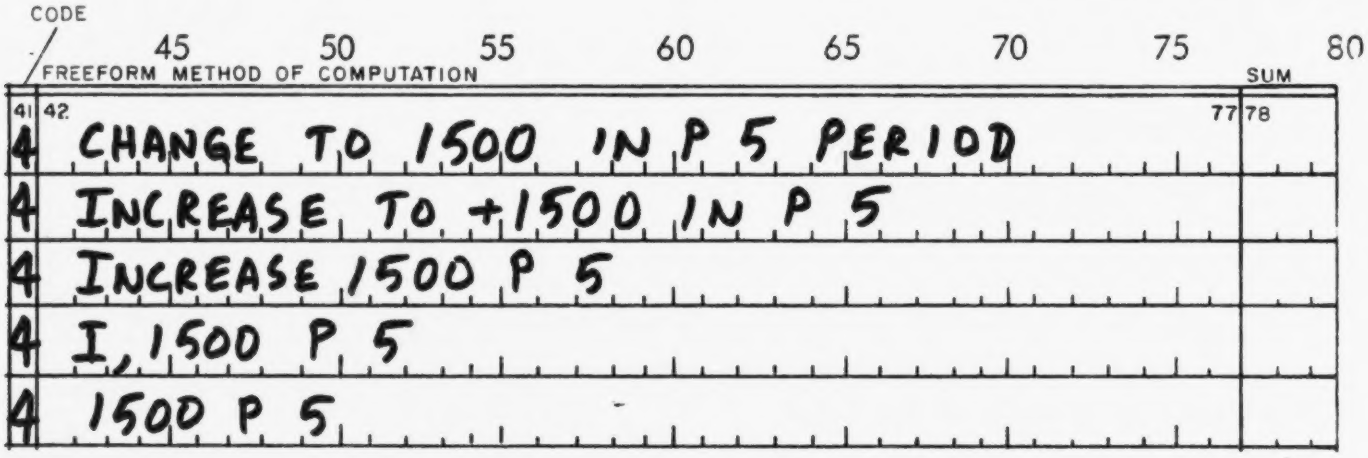
CODE 41	FREEFORM METHOD OF COMPUTATION 42	SUM 78
3	CHANGE BY 150. PER PERIOD	
3	INCREASE +150. PER PERIOD	
3	INCR 150/PR	
3	I,150	
3	150	

For a reduction of 150 per period along the planning horizon, any of these terms could be used:

CODE 41	FREEFORM METHOD OF COMPUTATION 42	SUM 78
3	CHANGE BY -150 PER PERIOD	
3	DECREASE 150./PERIOD	
3	DECR 150/PR	
3	INCREASE -150. PER PR	
3	D,150	
3	-150.	

This instruction produces a variable consisting of period values that are the incremental amount above (or below) the values of the previous period. If the METHOD field is left blank, the increment is assumed to be zero and the value that has been entered in the base level field will be inserted in each planning period. The character "D" is reserved, and should not be used unless a decrease is desired.

Change to a goal value in a specified number of periods. A planner can use this instruction to insert a goal value and to specify the planning period in which the goal is to be reached. The variable is generated by calculating the difference between the base level field and the goal level, and equally distributing that difference either by adding it to, or subtracting it from, each intervening period up to the specified goal period. If the goal value is specified for a period earlier than the last in the planning horizon, the goal value will be retained for the remaining periods. The numeral "4" must be present in the CODE field. The following terms show how this instruction can be reflected in the METHOD field to cause, for example, an increase to 1500 in the fifth period of the planning horizon:



CODE 41	FREEFORM METHOD OF COMPUTATION 42 45 50 55 60 65 70 75 77	SUM 78 80
4	CHANGE TO 1500 IN P 5 PERIOD	
4	INCREASE TO +1500 IN P 5	
4	INCREASE 1500 P 5	
4	I, 1500 P 5	
4	1500 P 5	

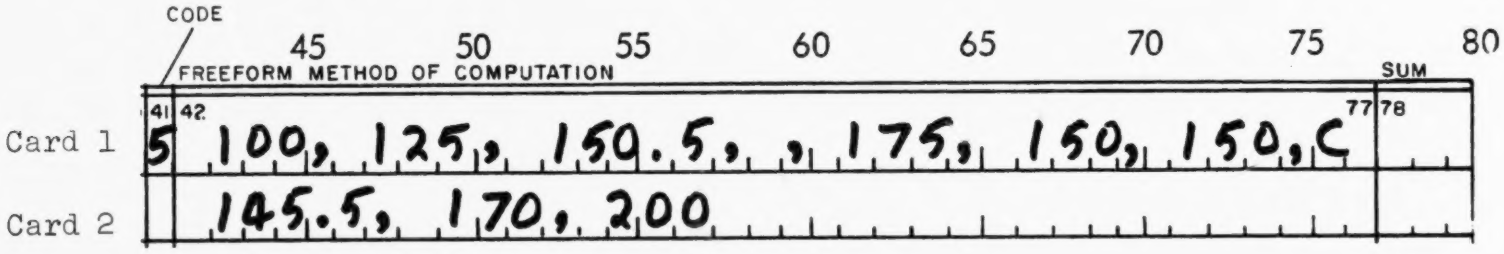
Note that the period in which the goal is to be achieved must be preceded by the letter "P," a reserved character.

Insert constant values into planning periods. This instruction allows the planner to insert values into any or all of the planning periods. For this instruction, a comma (,) is used as the delimiter to separate planning periods. If more than the 36 columns of the METHOD field are required to contain the data, the letter "C" must be used to continue the data on the method field of a following card. The use of this instruction requires the numeral "5" to be present in the CODE field. If a planning period is to be skipped (set to zero), the comma delimiter follows blank columns, or immediately follows the preceding comma.

As an example of how constant values can be inserted into planning periods, the numbers below show planning periods and values for each period.

Planning Period:	1	2	3	4	5	6	7	8	9	10
Values:	100	125	150.5	0	175	150	150	145.5	170	200

These data would require two cards. On the first card all of the data fields would be used. On the second card only the METHOD field would have to be used. The example below shows how the CODE and METHOD field would appear on the two cards:


CODE
45
50
55
60
65
70
75
80
FREEFORM METHOD OF COMPUTATION
SUM
41
42
77
78

Card 1 5 100, 125, 150.5, , 175, 150, 150, C

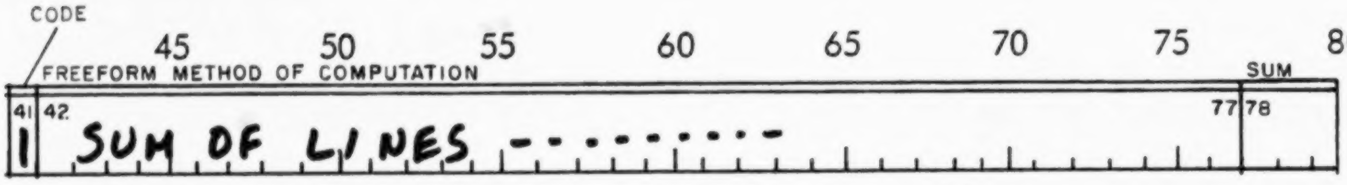
Card 2 145.5, 170, 200

Since commas are used as delimiters, they cannot be used to separate thousands or millions. In other words, if a number of four or more digits is entered it must be written without commas: 10932 not 10,932. The character "C" is reserved. Finally, the value to be inserted in an individual planning period has a maximum of eight digits, plus a sign, plus a decimal point.

Dependent Variables

Instructions for handling dependent variables are the most powerful of all the instructions in the planning system. It is this capacity to interrelate lines in an almost unlimited fashion that permits the construction of a model that represents an organization. There are five basic instructions for handling dependent variables: summary of other lines, function of other variables, maximum or minimum of other variables, accumulative sum (or product) of other variables, and constant value times last period value of another variable.

Summary of other lines. This instruction permits any number of other variables, regardless of how they were derived, to be summarized. The summarized line can even be included in another summary line, as long as there is the capability for generating sub-subtotals, subtotals, and final totals. There is no limit to the number of variables that can be included in a summary variable. To indicate a summary variable, the numeral "1" must be present in the CODE field. The METHOD field is not used in processing the variable. However, it may be used for comments to aid the planner in documenting his model. Line numbers of the variables included in the summary variable may be shown in the method field. The lines to be included in the summary must contain the line number of the summary line in their SUM field.



Function of other variables. This instruction permits the use of up to four other variables, constant values, or constant values times variables in combinations of addition subtraction, division, and multiplication.

In using this instruction, the numeral "6" must be entered in the code field. Other symbols and terms that are used in the instruction and their meanings are:

( ) indicates the arithmetic operation desired in the calculation.

+ indicates addition.

- indicates subtraction.

/ indicates division.

* indicates multiplication.

C indicates that the function is continued on the method field of the next card. This is a reserved character.

Line number is any line number inserted by the planner. Use of a line number is optional, but if one is used, it must be preceded by the character "L," which is reserved.

Constant value is any real or integer value inserted by the planner. Use of this value is optional and the value is assumed to be 1.0 if left blank.

The function desired for the variable is expressed in the method field as:

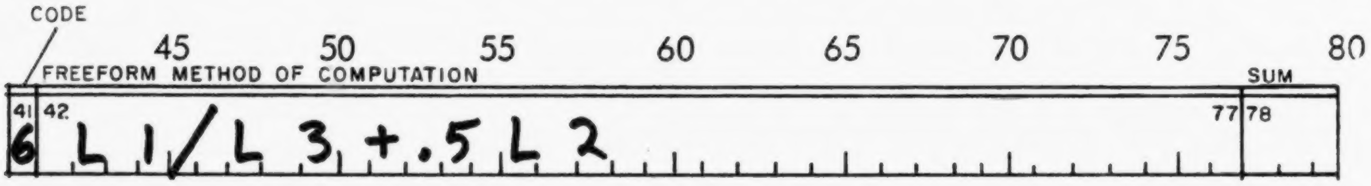
Constant Value$_1$ times Line Number$_1$ $\left(\begin{smallmatrix}+\\-\\/\\*\end{smallmatrix}\right)$ Constant Value$_2$ times Line Number$_2$ $\left(\begin{smallmatrix}+\\-\\/\\*\end{smallmatrix}\right)$

Constant Value$_3$ times Line Number$_3$ $\left(\begin{smallmatrix}+\\-\\/\\*\end{smallmatrix}\right)$ Constant Value$_4$ times Line Number$_4$.

The following lines provide an example of this instruction:

Period	1	2	3	4	5	6	7	8	9	10
Line No. 1	100	110	120	130	140	150	160	170	180	190
Line No. 2	10	20	30	40	50	60	70	70	70	70
Line No. 3	2	2	2	2	3	3	3	3	4	4

In the METHOD field the following term is specified:


CODE
45
50
55
60
65
70
75
80
FREEFORM METHOD OF COMPUTATION
SUM
41
42
77
78

6 L1/L3+.5L2

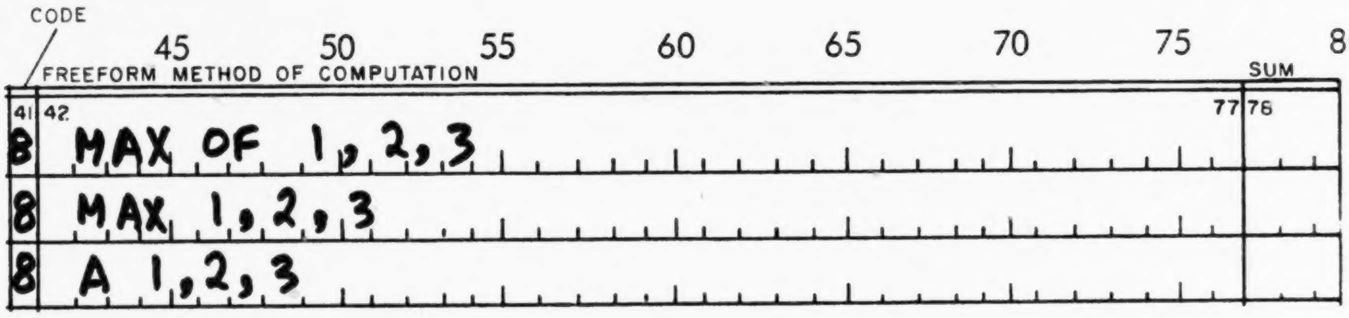
This example means that line number 1 is to be divided by line number 3 plus 0.5 times number 2. The result of the above calculation is:

Period	1	2	3	4	5	6	7	8	9	10
Result	55.0	65.0	75.0	85.0	71.6	80.0	88.3	91.6	80.0	82.5

Maximum or minimum of other variables. This instruction is used to examine up to four other variables to identify a variable that is either the maximum or the minimum value in each separate planning period contained within the variables being examined. The numeral "8" must be entered in the CODE field. At least two variables must be specified in the METHOD field, following an indicator to reflect maximum or minimum. The following examples show these variables and the terms used to obtain both the maximum and minimum variables.

Period	1	2	3	4	5	6	7	8	9	10
Line No. 1	10	20	30	40	50	60	70	70	70	70
Line No. 2	2	4	8	16	32	64	128	156	156	156
Line No. 3	70	60	50	20	20	20	20	20	20	20

First, to obtain the maximum, the following terms could be used in the METHOD field:

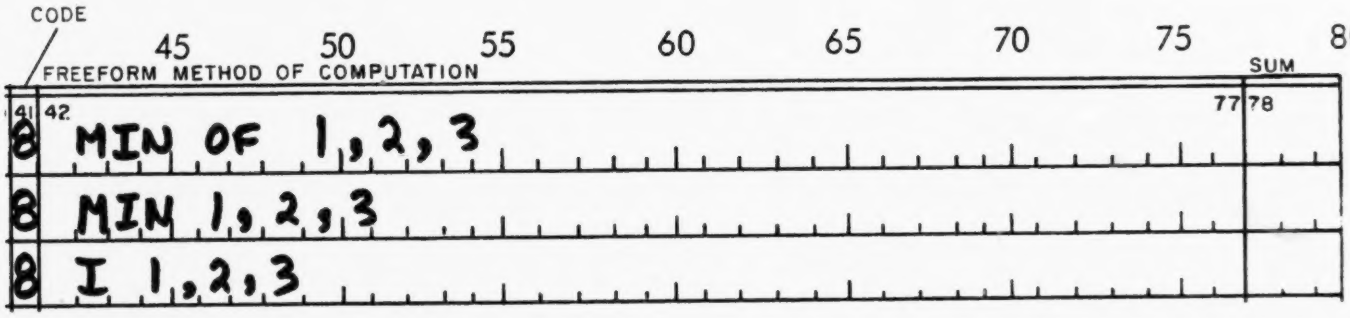


CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78–80
8	MAX OF 1,2,3	
8	MAX 1,2,3	
8	A 1,2,3	

The result of any of these terms would be:

Period	1	2	3	4	5	6	7	8	9	10
Result	70	60	50	40	50	64	128	156	156	156

To obtain the minimum of the same three variables, the following terms could be used:



CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78–80
8	MIN OF 1,2,3	
8	MIN 1,2,3	
8	I 1,2,3	

The result would be:

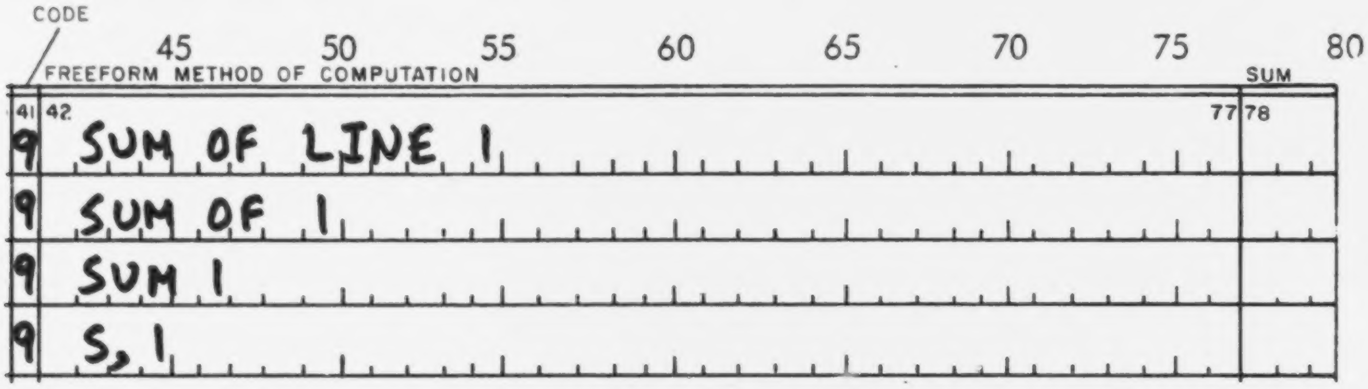
Period	1	2	3	4	5	6	7	8	9	10
Result	2	4	8	16	20	20	20	20	20	20

Note that the variables to be examined for maximum or minimum are separated within the term by the comma delimiter. Note that the characters "A" and "I" are both reserved, with "A" standing for maximum and "I" standing for minimum.

Accumulative sum, or product, of another variable. This instruction produces an accumulative summation of a variable, period by period across the entire planning horizon. The first period value is added to the second period variable, which is then added to the third period variable, and so on. It also provides for the accumulative product of period values of a variable in which each value is multiplied by the value of the preceding period. The use of the BASE LEVEL field is optional. The CODE field must contain the numeral "9." To provide an example of both uses of this instruction, we will use the following variables:

Period	1	2	3	4	5	6	7	8	9	10
Line No. 1	1	2	3	4	2	1	1	1	0	2

To generate the accumulative sum, one of the following terms could be used in the METHOD field:

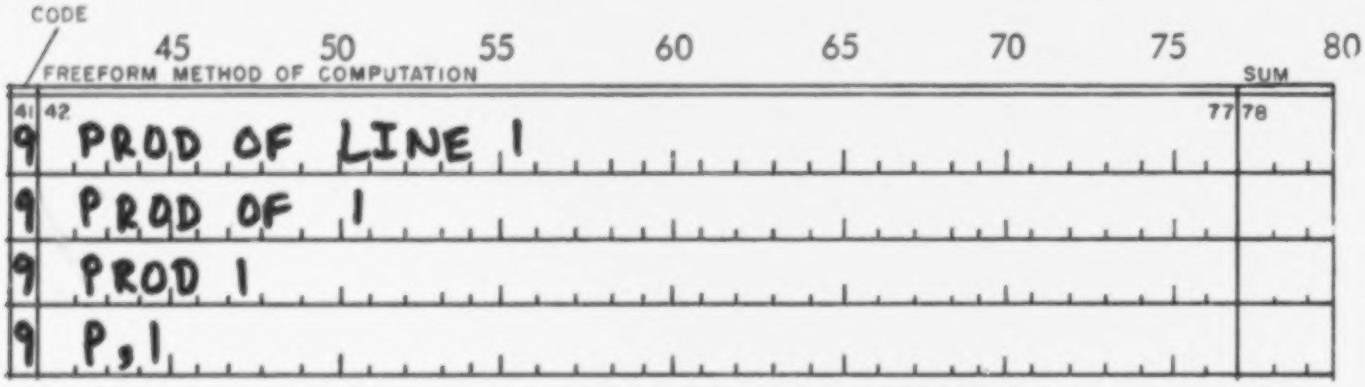

CODE
45
50
55
60
65
70
75
80
FREEFORM METHOD OF COMPUTATION
SUM
41
42
77
78

9 SUM OF LINE 1
9 SUM OF 1
9 SUM 1
9 S, 1

The result of any of the above terms would be:

Period	1	2	3	4	5	6	7	8	9	10
Result	1	3	6	10	12	13	14	15	15	17

To generate the accumulative product, any of the following terms could be used:


CODE
45
50
55
60
65
70
75
80
FREEFORM METHOD OF COMPUTATION
SUM
41
42
77
78

9 PROD OF LINE 1
9 PROD OF 1
9 PROD 1
9 P, 1

The result of any of the above terms would be:

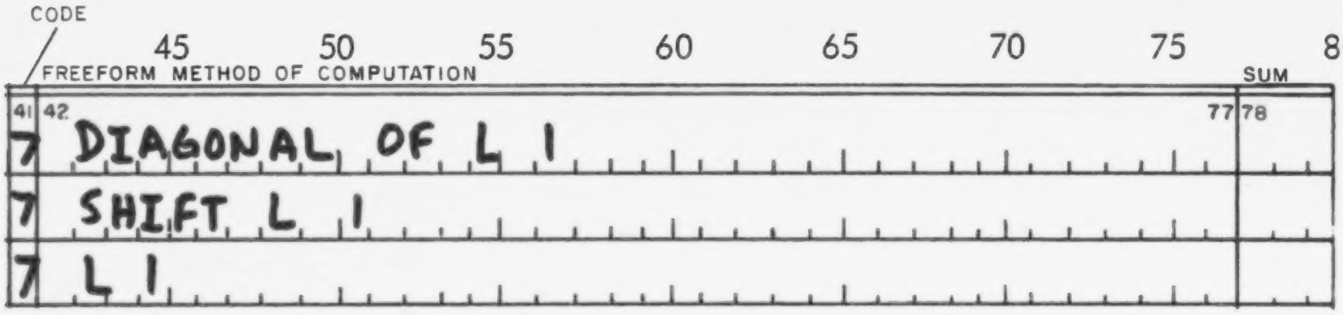
Period	1	2	3	4	5	6	7	8	9	10
Result	1	2	6	24	48	48	48	48	0	0

When using the accumulative product option, if a period of the variable being accumulated contains a zero, that period and all following periods of the accumulative product variable will contain a zero. The characters "S" and "P" are both reserved, with "S" standing for summary, and "P" standing for product.

Constant value times last period's value of another variable. This instruction permits a variable to be shifted one period to the right, as when taking a constant value times the variable and moving it one period toward the planning horizon. Use of the instruction requires that a value be present in the BASE LEVEL field of the variable being shifted, or zero will be used. The BASE LEVEL is optional in the result variable. The CODE field must contain the numeral "7" in the result variable. If a constant value times the variable being shifted is desired, it must be shown in the term. If no constant factor is given, 1 is assumed. For an example of both uses of this instruction we will use the following variables:

Base level	Period									
100	1	2	3	4	5	6	7	8	9	10
Line No. 1	110	120	130	140	150	160	170	180	190	200

To shift the exact values of the above variable, any of the following terms could be used in the method field:

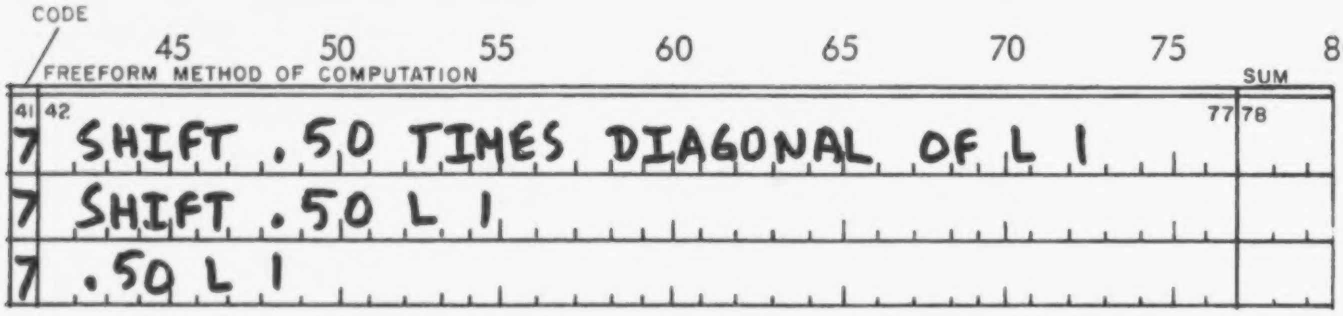

CODE
45
50
55
60
65
70
75
80
FREEFORM METHOD OF COMPUTATION
SUM
41
42
77
78

7 DIAGONAL OF L 1
7 SHIFT L 1
7 L 1

The result of any of the above terms would be:

Period	1	2	3	4	5	6	7	8	9	10
	100	110	120	130	140	150	160	170	180	190

To shift the variable times a constant value, one of the following terms could be used:


CODE
45
50
55
60
65
70
75
80
FREEFORM METHOD OF COMPUTATION
SUM
41
42
77
78

7 SHIFT .50 TIMES DIAGONAL OF L 1
7 SHIFT .50 L 1
7 .50 L 1

The result of any of the above terms would be:

Period	1	2	3	4	5	6	7	8	9	10
	50	55	60	65	70	75	80	85	90	95

Note that in either option, the line number of the variable being shifted is preceded by the character "L". This character is required and is a reserved character.

The above description completes the instructions for the dependent variables. There is one more instruction in the PLANTRAN language set. It provides for the division of sections of the model, and inserting of comments, by the use of headings.

Headings

The final type of instruction input in the PLANTRAN language concerns the use of headings. The use of headings permits the model to be divided into sections and the insertion of explanatory and other comments.

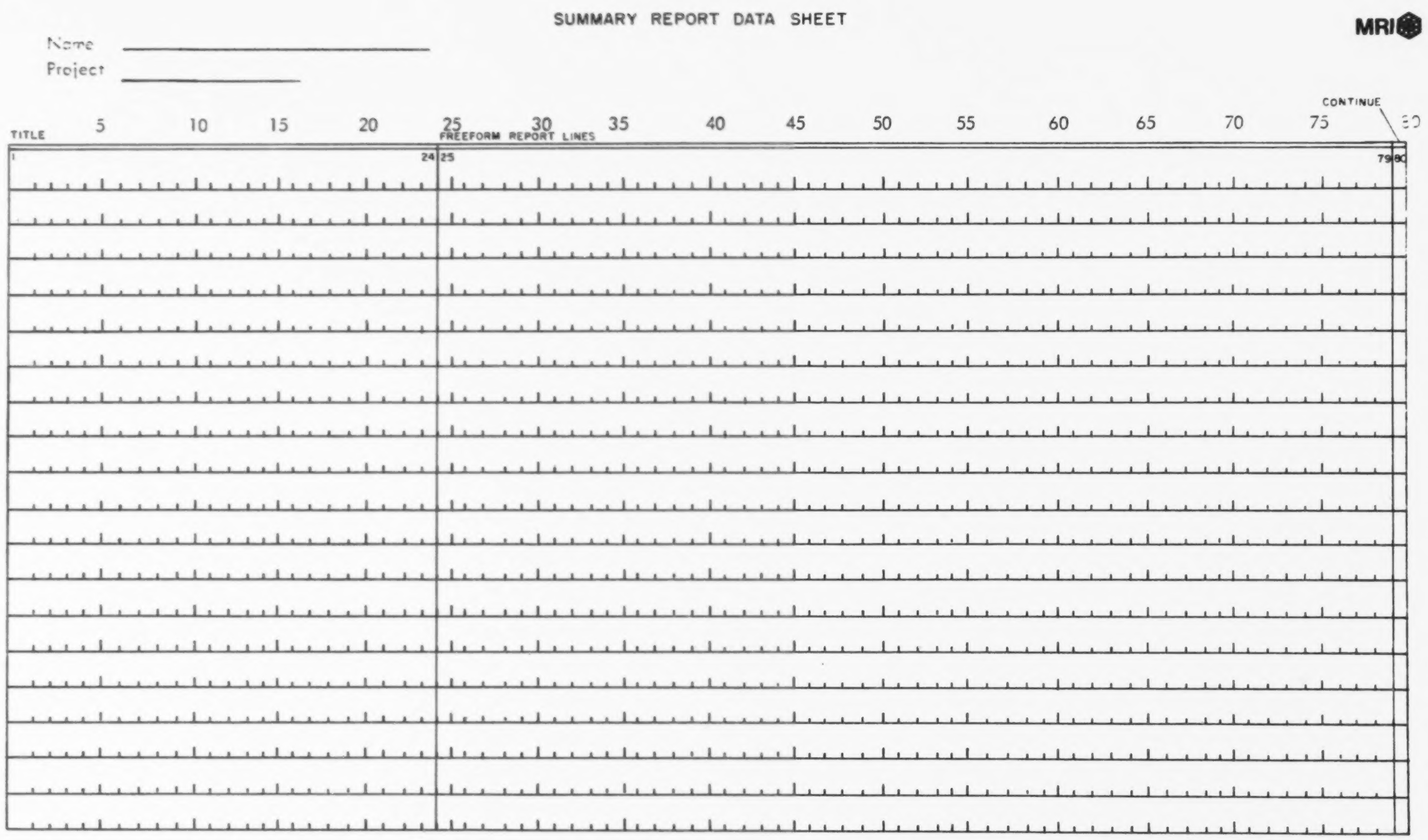
To include a heading or comment in the model printout, the LINE NUMBER and PLANNING ITEM fields are used. The LINE NUMBER field is required, just as in any other instruction. The heading or comment is placed in the PLANNING ITEM field. The CODE field must be left blank. The absence of characters in the CODE field causes the data that have been entered in the PLANNING ITEM field to be printed to the left of other planning item information in the analysis of planning matrix, and in the center of the summary report output.

SUMMARY REPORT INPUT

The third type input format for PLANTRAN is the summary report input. This input permits the planner to title and specify the content of summary reports. The format that is used for this input is shown in Figure 7. The data fields on the summary report input sheet are:

Field 1--Columns 1-24, TITLE. This space is for the title that is to appear on the report.

Field 2--Columns 25-79, FREEFORM REPORT LINES. This space should contain the line numbers of the planning items, or variables, that are to be included in the summary report.



SUMMARY REPORT DATA SHEET

MRI

Name ____________________

Project ______________

CONTINUE
TITLE
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
FREEFORM REPORT LINES
1
24
25
79
80

Figure 7

Field 3--Column 80, CONTINUE. This field indicates the presence of additional cards (or additional lines) that are to be included in the report. Specification of what a summary report is to be called and what it is to contain is accommodated within the format of this card. This specification may extend to two or more cards.

The TITLE field allows the planner to give a unique name to the report that will logically identify the content of the report. Up to 24 columns of data are permitted in this field.

The FREEFORM REPORT LINES field is used to specify the variables or planning items to be included in the report. Variables may be uniquely identified by specifying the actual line number, or they may be included in a sequence of line numbers. Individual line numbers are separated by commas (,). Sequences are denoted by specifying the first line number in the sequence, followed by a dash or hyphen, and then the last line number in the sequence. To continue the report lines field to another card, the character C should be inserted in the CONTINUE field. There is no limit to the number of times a line number may be specified, nor is there any limit to the number of cards to be used in specifying a summary report. Blanks may be present in the report lines field. For an example, Figure 8 shows the input format required to create a summary report titled Financial Report, and containing line numbers 1, 3, 5 through 11, 14, 16 through 22, 27, 29, 31, 30, 46, 48, 50 through 61, 70 through 82, 85, 87, 91, and 100. The lines will appear on the summary report in the sequences indicated above. For additional summary reports having a different title and other line number content, the above process is repeated on another line of the summary report data sheet.

This chapter has described the basic elements of PLANTRAN. The next chapter discusses the design of a planning model, using the various kinds of instructions in the modeling language.

SUMMARY REPORT DATA SHEET

MRI

Name ____________________

Project ______________

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

TITLE 1–24	FREEFORM REPORT LINES 25–79	CONTINUE 80
FINANCIAL REPORT	1, 3, 5-11, 14, 16-22, 27, 29, 31, 30, 46, 48, 50-61, 70-82, 85,	C
	87, 91, 100	

Figure 8

CHAPTER V

EXAMPLES OF MODEL DESIGN

At this point, we are ready to use the modeling language to structure specific information relating to an organization. This structuring process will build the planning model. In developing the model, there are several important considerations:

1. Data about the detailed characteristics of the organization must be available.
2. The known and assumed facts that influence the operation of the organization through time should have quantifiable interrelationships.
3. The ability to assess accurately the overall relationships among components of the organization is less reliable than the knowledge of the individual components.
4. Construction of a model and observation of the interaction of the factors contained within it provide greater understanding of the operation of the organization.
5. The results do not have to be perfect to be helpful.

As the planner begins to construct the model, he should keep these considerations in mind. Of course, in actually designing the model, a systematic approach is important. The following guide, "Steps in Model Design," is one way to approach the model building task.

Steps in Model Design

1. Specify the planning objectives: The choice of significant objectives depends on the planner's knowledge of his organization and on his ability to relate that knowledge to causes and effects. The final value to be derived from the model can be enhanced by the clarity of those objectives or goals.
2. Relate boundaries to the objectives: There are limits to the objectives, and these should be determined or at least taken into account if a realistic model is to be constructed.

3. Identify items to be contained within the model: These items, or variables, must be the elements of which the organization is comprised. They must be identified at a level of detail to accommodate the model objectives.

4. Determine relationships between interconnected elements: The interacting items, or dependent variables, must reflect the relationship of the interconnected elements of the organization. This must be done in a manner that permits examination of the effects of the variables under study.

5. Set item values at realistic levels: The values of the variable must be set at levels that are valid, or if not known, are at least within reason.

In designing a model, the normal procedure is to build upward from available knowledge about the individual planning items. In some cases, it may be desirable, or even necessary, to construct a variable by working backward from the known results. The following two examples demonstrate the flexibility of the modeling language in relation to these two design approaches and show how elements of planning information may be obtained.

The first example, illustrated in Figures 9, 10, and 11, consists of determining two result variables--one for Line 12, Fees/Student, and the other for Line 13, Endowment, Gift, and Grant Income. These elements are being examined at this particular run.

Figure 9 shows the line number, the planning item, the base level (where applicable), and the method of computation used to generate the variable. Figure 10 shows the instruction data sheet input. Figure 11 shows the model program output for each variable through the entire planning horizon. Note that in this model the given elements, or independent variables of Faculty, Student-Faculty Ratio, Average Faculty Compensation, Departmental Expense, Administration and General Expense, and Percent G & E from Fees were used to derive, through interline relationships, all the remaining dependent variables. The interline relationships remain the same for these dependent variables across the planning horizon. The values differ due to changes in the independent variables.

The second example, shown in Figures 12, 13, and 14, determines four result variables--Total Fee, Income, Faculty, Total Faculty Compensation and Total Department Expense. Note that Fees/Student, which was a dependent or result variable in the first example, is an independent variable in this example. Figure 12 shows the line number, the planning item, the base level, and the method of computation. Figure 13 shows the instruction data sheet input. Figure 14 shows the results of the model.

LINE NO.	ITEM	BASE	METHOD OF COMPUTATION
1	FACULTY	30.	INCREASE BY 2. PER YEAR.
2	STUDENT-FACULTY RATIO	25.5	DECREASE BY .5 PER YEAR.
3	STUDENTS		LINE 1 TIMES LINE 2.
4	AVERAGE FACULTY COMPENSATION	10500.	INCREASE BY 2% PER YEAR.
5	DEPARTMENT EXPENSE	14500.	INCREASE BY 250. PER YEAR.
6	INSTRUCTION EXPENSE		LINE 1 TIMES LINE 4 PLUS LINE 5.
7	ADMIN. AND GEN. EXPENSE	315000.	INCREASE BY 20000. PER YEAR.
8	TOTAL G AND E EXPENSE		LINE 6 PLUS LINE 7 DIVIDED BY .94.
9	LIBRARY		LINE 8 TIMES .06.
10	PERCENT G AND E FROM FEES	58.	INCREASE BY 1.5 PER YEAR.
11	TOTAL FEE INCOME		.01 TIMES LINE 8 TIMES LINE 10.
12	FEES/STUDENT		LINE 11 DIVIDED BY LINE 3.
13	ENDOWMENT GIFT AND GRANT		LINE 8 MINUS LINE 11.

Figure 9

INSTRUCTION DATA SHEET MRI

Name
Project MODEL DESIGN EXAMPLE 1

LINE NO	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1		FACULTY	30.	3	INCREASE BY 2. PER YEAR	
2		STUDENT-FACULTY RATIO	25.5	3	DECREASE BY .5 PER YEAR	
3		STUDENTS		6	L1 * L2	
4		AVERAGE FACULTY COMPENSATION	10500.	2	INCREASE BY 2% PER YEAR	
5		DEPARTMENT EXPENSE	14500.	3	INCREASE BY 250. PER YEAR	
6		INSTRUCTION EXPENSE		6	L1 * L4 + L5	
7		ADMIN AND GEN EXPENSE	315000.	3	INCREASE BY 20000. PER YEAR	
8		TOTAL G AND E EXPENSE		6	L6 + L7 /.94	
9		LIBRARY		6	L8 * .06	
10		PERCENT G AND E FROM FEES	48.	3	INCREASE BY 1.5 PER YEAR	
11		TOTAL FEE INCOME		6	.01 L8 * L10	
12		FEES / STUDENT		6	L11 / L3	
13		ENDOWMENT GIFT AND GRANT		6	L8 - L11	

Figure 10

```
SUMMARY REPORT OVERVIEW MODEL FXAMPLE
MODEL DESIGN EXAMPLE 1                                                                                  JAN. 14,1971

    PLANNING ITEM                        YR 1      YR 2      YR 3      YR 4      YR 5      YR 6      YR 7      YR 8      YR 9      YR10

  1 FACULTY                              32.0      34.0      36.0      38.0      40.0      42.0      44.0      46.0      48.0      50.0

  2 STUDENT-FACULTY RATIO                25.0      24.5      24.0      23.5      23.0      22.5      22.0      21.5      21.0      20.5

  3 STUDENTS                              800       833       864       893       920       945       968       989      1008      1025

  4 AVERAGE FACULTY COMPENSATION        10919     11356     11811     12283     12774     13285     13817     14369     14944     15542

  5 DEPARTMENTAL EXPENSE                14750     15000     15250     15500     15750     16000     16250     16500     16750     17000

  6 INSTRUCTION EXPENSE                364189    401131    440448    482273    526744    574005    624210    677518    734099    794128

  7 ADMIN AND GEN EXPENSE              335000    355000    375000    395000    415000    435000    455000    475000    495000    515000

  8 TOTAL G AND E EXPENSE              743819    804394    867498    933269   1001855   1073410   1148096   1226083   1307552   1392689

  9 LIBRARY                             44629     48263     52049     55996     60111     64404     68885     73565     78453     83561

 10 PERCENT G AND E FROM FEES            49.5      51.0      52.5      54.0      55.5      57.0      58.5      60.0      61.5      63.0

 11 TOTAL FEE INCOME                   368190    410241    455436    503965    556029    611843    671636    735650    804144    877394

 12 FEES / STUDENT                      460.2     492.5     527.1     564.4     604.4     647.5     693.8     743.8     797.8     856.0

 13 ENDOWMENT GIFT AND GRANT           375628    394153    412061    429304    445825    461566    476459    490433    503407    515295
```

Figure 11

LINE NO.	ITEM	BASE	METHOD OF COMPUTATION
1	STUDENTS	800.	INCREASE BY 3% PER YEAR.
2	FEES/STUDENT	550.	INCREASE BY 7% PER YEAR.
3	TOTAL FEE INCOME	--	LINE 1 TIMES LINE 2.
4	STUDENT-FACULTY RATIO	23	CHANGE TO 18. IN 5 YEARS.
5	FACULTY	--	LINE 1 DIVIDED BY LINE 4.
6	AVERAGE FACULTY COMPENSATION	10500.	INCREASE BY 4% PER YEAR.
7	TOTAL FACULTY COMPENSATION		LINE 5 TIMES LINE 6.
8	DEPARTMENT EXPENSE/FACULTY	500.	INCREASE BY 3% PER YEAR.
9	TOTAL DEPARTMENT EXPENSE		LINE 5 TIMES LINE 8.
10	ADMIN. AND GEN. EXPENSE	315000.	INCREASE BY 20000. PER YEAR.
11	LIBRARY AS PERCENT G AND E	5.	INSERT 5. IN YEARS 1-3, 6. IN YEARS 4-7, 7. IN YEARS 8-10.
12	TOTAL G AND E EXPENSE		SUM OF LINES 7, 9, AND 10.
13	LIBRARY		.01 TIMES LINE 11 TIMES LINE 12.
14	NON-FEE INCOME		LINE 12 MINUS LINE 3.

Figure 12

INSTRUCTION DATA SHEET

MRI

Name

Project MODEL DESIGN EXAMPLE 2

LINE NO	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1		STUDENTS	800.	2	INCREASE BY 3% PER YEAR	
2		FEES / STUDENT	550.	2	INCREASE BY 7% PER YEAR	
3		TOTAL FEE INCOME		6	L1 * L2	
4		STUDENT-FACULTY RATIO	23.	4	CHANGE TO 18. IN P5	
5		FACULTY		6	L1 / L4	
6		AVERAGE FACULTY COMPENSATION	10500.	2	INCREASE BY 4% PER YEAR	
7		TOTAL FACULTY COMPENSATION		6	L5 * L6	12
8		DEPARTMENT EXPENSE / FACULTY	500.	2	INCREASE BY 3% PER YEAR	
9		TOTAL DEPARTMENT EXPENSE		6	L5 * L8	12
10		ADMIN AND GEN EXPENSE	315000.	3	INCREASE BY 20000. PER YEAR	12
11		LIBRARY AS PERCENT G AND E	5.	5	5, 5, 5, 6, 6, 6, 6, 7, 7, 7	
12		TOTAL G AND E EXPENSE		1	SUMMARY OF LINES 7, 9, AND 10	
13		LIBRARY		6	.01 L11 * L12	
14		NON-FEE INCOME		6	L12 - L3	

Figure 13

```
SUMMARY REPORT OVERVIEW MODEL EXAMPLE
MODEL DESIGN EXAMPLE 2                                                                                    JAN. 14,1970

     PLANNING ITEM                      BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

  1 STUDENTS                             800      823      848      874      900      927      955      983     1013     1043     1075

  2 FEES / STUDENT                       550      588      629      673      720      771      825      883      945     1011     1081

  3 TOTAL FEE INCOME                       0   484923   534434   589000   649137   715414   788458   868959   957680  1055459  1163222

  4 STUDENT-FACULTY RATIO               23.0     22.0     21.0     20.0     19.0     18.0     18.0     18.0     18.0     18.0     18.0

  5 FACULTY                             -0.0     37.5     40.4     43.7     47.4     51.5     53.1     54.7     56.3     58.0     59.7

  6 AVERAGE FACULTY COMPENSATION       10500    10919    11356    11811    12283    12774    13285    13817    14369    14944    15542

  7 TOTAL FACULTY COMPENSATION             0   409003   458987   516251   582113   658202   705066   755267   809042   866646   928351

  8 DEPARTMENT EXPENSE/FACULTY         500.0    515.0    530.4    546.4    562.8    579.6    597.0    614.9    633.4    652.4    672.0

  9 TOTAL DEPARTMENT EXPENSE               0    19289    21438    23881    26668    29864    31683    33613    35660    37831    40135

 10 ADMIN AND GEN EXPENSE             315000   335000   355000   375000   395000   415000   435000   455000   475000   495000   515000

 11 LIBRARY AS PERCENT G AND F           5.0      5.0      5.0      5.0      6.0      6.0      6.0      6.0      7.0      7.0      7.0

 12 TOTAL G AND F EXPENSE                  0   763292   835426   915132  1003782  1103067  1171750  1243880  1319702  1399478  1483487

 13 LIBRARY                                0    38164    41771    45756    60226    66184    70305    74632    92379    97963   103944

 14 NON-FEE INCOME                         0   278368   300991   326131   354645   387653   383291   374920   362021   344018   320265
```

Figure 14

These two examples show that unknown, or effect, elements, can be derived from known, or cause, elements, whether the unknown elements are general or specific. What is required is that the relationships between elements are known and that they can be expressed in mathematical terms.

The above examples are rather simple and broad in scope in order to demonstrate the design concept from different points of view. The following example is one of a much more detailed model. The identification of the level of detail required is a crucial aspect in model design. This particular example concerns a faculty salary analysis.

Figure 15 shows the "outline of plans" worksheet associated with the example. The Planning Subject is divided into several categories of faculty quality and satisfaction. The one we will deal with is 1.1, Salary. The Long Range Program Goal is "to upgrade quality and satisfaction of professors by increasing the average compensation, changing the distribution of faculty by rank, and increasing the student-to-faculty ratio." The Problem Statement column contains information on the current status of factors relating to the goals; in the Long Range Program Goals column is similar information relating to where salaries should be in 5 years. The following is a breakout of the information.

1. Average Faculty Salary

Rank	Current Salary	5-Year Goal Salary
Professor	$11,500	$22,571
Associate	10,970	15,233
Assistant	10,090	14,076
Instructor	8,100	11,196

2. Distribution of Faculty by Rank

Rank	Current Percentage	5-Year Goal Percentage
Professor	35	20
Associate	25	30
Assistant	20	30
Instructor	20	20

3. Student-to-Faculty Ratio

Current Ratio	5-Year Goal Ratio
12:1	20:1

OUTLINE OF PLANS

☐ Worksheet
☐ Discussion Draft
☐ Proposed Draft
☐ Approved Plan

Name of Institution or Department

Plan Date | Replaces Plan Of | Next Review Date

1. Urgent Need
2. Important Need
3. Moderate Need
4. Minimal Need

Index of Need

Index of Difficulty

1. Not Difficult
2. Moderately Difficult
3. Highly Difficult
4. Very Highly Difficult

Planning Subject	Problem Statement	Long Range Program Goal:	Plan Of Action	Resource Identification And Development Plans	▽	▽	Composite Priority	Organizations Concerned With Planning, Decisions and Action	Objectives And Milestones By Years
Faculty Quality & Satisfaction 1. Compensation 1.1 Salary 1.2 Fringe Benefits 1.3 Total Compensation 1.4 Future Salary Prospects 2. Job Related Factors 2.1 Courses Taught 2.2 Teaching Load 2.3 Research Facilities & Opportunities 2.4 Competency of Colleagues 2.5 Reputation of School 2.6 Quality of Students 2.7 Nature of Administration and administrators 3. Environmental Factors 3.1 Cultural Opportunities 3.2 Congeniality of Colleagues 3.3 Nearness to Graduate School 3.4 Climate 3.5 Moonlighting Opportunities	1. Current Average Faculty Salary Rank AAUP Salary Professor D $11,500 Associate C 10,970 Assistant B 10,090 Instructor B 8,100 2. Distribution of Faculty by Rank Professor 35% Associate 25% Assistant 20% Instructor 20% 3. Student Faculty Ratio 12:1 4. F.T.E. Student Enrollment Has Remained Constant During the Last 5 Years 5. Salary Distribution Professor 142 % Associate 135 % Assistant 124 % Instructor 100 %	To upgrade quality and satisfaction of professors by increasing the average compensation, changing the distribution of faculty by rank and increasing the student to faculty ratio. 1. Average Faculty Salary Rank AAUP Salary Professor B $22,571 Associate B 15,233 Assistant A 14,076 Instructor A 11,196 2. Distribution of Faculty by Rank Professor 20% Associate 30% Assistant 30% Instructor 20% 3. Student Faculty Ratio to 20:. 4. Increase Student Body by 30 F.T.E. Students from Base 800. 5. Salary Distribution - "B" Scale Professor 220 % Associate 157 % Assistant 125 % Instructor 100 %	To change internal structure of college while maintaining the integrity of program curricula by obtaining real understanding and agreement from parties concerned. A. Obtain Authorization 1. Personnel committee and the Dean request planning officer to investigate means to increase average salaries. 2. Planning officer examines trade-offs among alternative expenditures, including increased salaries, prepares report to faculty body. 3. Faculty body and student representatives review planning officer's report; they set up Ad Hoc Committees to do field work which includes visits to colleges with similar problems and motives, meet with AAUP representatives. Ad Hoc Committee prepares report to faculty body and student senate. 4. Faculty body and student senate meet to review, revise and approve report. 5. Academic Affairs Committee meet to review, revise and approve recommended plan. 6. Board of Trustees meet to review, revise, and approve recommended plan. B. Implementation 7. Alumni groups more actively assist in the identification, selection and recruitment of new students. 8. Change the nature of faculty recruitment, hire fewer faculty, but better quality by recruiting more actively and advertise more openly. C. Follow-up 9. Monitor progress toward satisfaction of long-range goals, if progress is substantially different either revise strategy or long-range goals.	Dean of College Personnel Committee Planning Officer Faculty Senate Faculty Body Student Senate Chapter AAUP Representatives Academic Affairs Committee Board of Trustees State Board of Regents State Legislature Alumni Groups General Community Leaders				Dean of College Personnel Committee Planning Officer Faculty Senate Faculty Body Student Senate Academic Affairs Committee Board of Trustees State Board of Regents State Legislature Alumni Groups	See Computer Printout of the Faculty Salary Planning Model

Figure 15

4. FTE Student Enrollment

Current Status	5-Year Goal Status
Constant at 800	Increase 30 per year from 800

5. Salary Distribution by Rank

Rank	Current Percentage	5-Year Goal Percentage
Professor	142	220
Associate	135	157
Assistant	124	125
Instructor	100	100

It is quickly apparent that these variables have significant relationships, and that to analyze individually each of the alternatives concerning the variables would be tedious and time consuming.

Conversion of this salary analysis and related data to the format of the planning language provides the basis for analysis of the effects of varying distributions of faculty by rank, distributions of salaries by rank, and average salaries--all within the framework of changes in the FTE enrollment and student-to-faculty ratio variables.

Conversion of the information to the planning language is rather simple. Figure 16 shows the line number, base data, and method of computation required for the task. Figures 17 and 18 show the instruction data sheet input to be used to generate the model. Figures 19 and 20 show the summary report output.

Once the model output is obtained, the planner, by examination and evaluation, determines which variables he wants to alter. This process of "exercising the model," noting the various effects on a check line, such as total faculty salaries, provides a basis for determining the most realistic course of action to follow. This type of planning information, for instance, can be helpful to colleges that want to achieve higher AAUP ratings, since importance is placed not only on raising overall average salaries, but also on adjusting the distribution of salaries among the ranks.

The end products of the model program, the reports, are designed for maximum flexibility--again the planner designs his own reports and may even change the format of the report for each run. The information contained in any line of the planning model can be printed any number of times, and

LINE NO.	ITEM	BASE	METHOD OF COMPUTATION
1	AVERAGE FACULTY SALARY	--	HEADING
2	PROFESSOR	11500.	CHANGE TO 22571. IN 5 YEARS.
3	ASSOCIATE	10970.	CHANGE TO 15233. IN 5 YEARS.
4	ASSISTANT	10090.	CHANGE TO 14076. IN 5 YEARS.
5	INSTRUCTOR	8100.	CHANGE TO 11196. IN 5 YEARS.
6			
7	DISTRIBUTION OF FACULTY RANK	--	HEADING
8	PROFESSOR	35.	CHANGE TO 20. IN 5 YEARS.
9	ASSOCIATE	25.	CHANGE TO 30. IN 5 YEARS.
10	ASSISTANT	20.	CHANGE TO 30. IN 5 YEARS.
11	INSTRUCTOR	20.	NO CHANGE
12			
13	STUDENT FACULTY RATIO	12.	INCREASE BY 1.6 PER YEAR.
14	FTE STUDENT ENROLLMENT	800.	INCREASE BY 30. PER YEAR.
15			
16	TOTAL NUMBER OF FTE FACULTY	66.6	LINE 14 DIVIDED BY LINE 13.
17	NUMBER PROFESSORS	23.3	.01 TIMES LINE 16 TIMES LINE 8.
18	NUMBER ASSOCIATES	16.6	.01 TIMES LINE 16 TIMES LINE 9.
19	NUMBER ASSISTANTS	13.3	.01 TIMES LINE 16 TIMES LINE 10.
20	NUMBER INSTRUCTORS	13.3	LINE 16 MINUS LINE 17 MINUS LINE 18 MINUS LINE 19.
21			
22	TOTAL FACULTY SALARY	691979.	SUM OF LINES 23, 24, 25, 26.
23	TOTAL PROFESSORS SALARY	267950.	LINE 17 TIMES LINE 2, SUM ON 22.
24	TOTAL ASSOCIATES SALARY	182102.	LINE 18 TIMES LINE 3, SUM ON 22.
25	TOTAL ASSISTANTS SALARY	134197.	LINE 19 TIMES LINE 4, SUM ON 22.
26	TOTAL INSTRUCTORS SALARY	107730	LINE 20 TIMES LINE 5, SUM ON 22.
27	AVERAGE FACULTY SALARY	10400.	LINE 22 DIVIDED BY LINE 16.
28	DISTRIBUTION OF SALARY - RANK		HEADING
29	PROFESSOR	142.0	100. TIMES LINE 2 DIVIDED BY LINE 5.
30	ASSOCIATE	135.0	100. TIMES LINE 3 DIVIDED BY LINE 5.
31	ASSISTANT	124.0	100. TIMES LINE 4 DIVIDED BY LINE 5.
32	INSTRUCTOR	100.0	100. TIMES LINE 5 DIVIDED BY LINE 5.

Figure 16

INSTRUCTION DATA SHEET

MRI

Name ______________________

Project ______________

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1		AVG FACULTY SALARY				
2		PROFESSOR	11500.	4	CHANGE TO 22571. IN P5 YEARS	
3		ASSOCIATE	10970.	4	CHANGE TO 15233. IN P5 YEARS	
4		ASSISTANT	10090.	4	CHANGE TO 14076. IN P5 YEARS	
5		INSTRUCTOR	8100.	4	CHANGE TO 11196. IN P5 YEARS	
6						
7		DISTRIBUTION OF FACULTY-RANK				
8		PROFESSOR	35.	4	CHANGE TO 20. IN P5 YEARS	
9		ASSOCIATE	25.	4	CHANGE TO 30. IN P5 YEARS	
10		ASSISTANT	20.	4	CHANGE TO 30. IN P5 YEARS	
11		INSTRUCTOR	20.	3		
12						
13		STUDENT FACULTY RATIO	12.	3	INCREASE BY 1.6 PER YEAR	
14		FTE STUDENT ENROLLMENT	800.	3	INCREASE BY 30. PER YEAR	
15						
16		TOTAL NUMBER OF FTE FACULTY	66.6	6	L14 / L13	
17		NUMBER PROFESSORS	23.3	6	.01 L16 * L8	
18		NUMBER ASSOCIATES	16.6	6	.01 L16 * L9	
19		NUMBER ASSISTANTS	13.3	6	.01 L16 * L10	

Figure 17

INSTRUCTION DATA SHEET

MRI

Name

Project

LINE NO (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78–80)
20		NUMBER INSTRUCTORS	13.3	6	L16 - L17 - L18 - L19	
21						
22		TOTAL FACULTY SALARY	691979.	1	SUM OF LINES 23, 24, 25, 26	
23		TOTAL PROFESSORS SALARY	267950.	6	L17 * L2	22
24		TOTAL ASSOCIATES SALARY	182102.	6	L18 * L3	22
25		TOTAL ASSISTANTS SALARY	134197.	6	L19 * L4	22
26		TOTAL INSTRUCTORS SALARY	107730.	6	L20 * L5	22
27		AVERAGE FACULTY SALARY	10400.	6	L22 / L16	
28		DISTRIBUTION OF SALARY-RANK				
29		PROFESSOR	142.	6	100. L2 / L5	
30		ASSOCIATE	135.	6	100. L3 / L5	
31		ASSISTANT	124.	6	100. L4 / L5	
32		INSTRUCTOR	100.	6	100. L5 / L5	
33		SUMMARY				

Figure 18

```
FACULTY SALARY ANALYSIS REPORT          FACULTY SALARY ANALYSIS     SAMPLE COLLEGE  -  1         JANUARY 21 1970

     PLANNING ITEM                  1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979


                                        SUMMARY

  14 FTE STUDENT ENROLLMENT          800      830      860      890      920      950      980     1010     1040     1070     1100

  16 TOTAL NUMBER OF FTE FACULTY    66.6     61.0     56.6     53.0     50.0     47.5     45.4     43.5     41.9     40.5     39.3

  13 STUDENT FACULTY RATIO          12.0     13.6     15.2     16.8     18.4     20.0     21.6     23.2     24.8     26.4     28.0

                                        AVG FACULTY SALARY BY RANK

   2 PROFESSOR                     11500    13714    15928    18142    20356    22571    22571    22571    22571    22571    22571

   3 ASSOCIATE                     10970    11822    12675    13527    14380    15233    15233    15233    15233    15233    15233

   4 ASSISTANT                     10090    10887    11684    12481    13278    14076    14076    14076    14076    14076    14076

   5 INSTRUCTOR                     8100     8719     9338     9957    10576    11196    11196    11196    11196    11196    11196

                                        DISTRIBUTION OF FACULTY-RANK

   8 PROFESSOR                      35.0     32.0     29.0     26.0     23.0     20.0     20.0     20.0     20.0     20.0     20.0

   9 ASSOCIATE                      25.0     26.0     27.0     28.0     29.0     30.0     30.0     30.0     30.0     30.0     30.0

  10 ASSISTANT                      20.0     22.0     24.0     26.0     28.0     30.0     30.0     30.0     30.0     30.0     30.0

  11 INSTRUCTOR                     20.0     20.0     20.0     20.0     20.0     20.0     20.0     20.0     20.0     20.0     20.0



  16 TOTAL NUMBER OF FTE FACULTY    66.6     61.0     56.6     53.0     50.0     47.5     45.4     43.5     41.9     40.5     39.3

  17 NUMBER PROFESSORS              23.3     19.5     16.4     13.8     11.5      9.5      9.1      8.7      8.4      8.1      7.9

  18 NUMBER ASSOCIATES              16.6     15.9     15.3     14.8     14.5     14.3     13.6     13.1     12.6     12.2     11.8

  19 NUMBER ASSISTANTS              13.3     13.4     13.6     13.8     14.0     14.3     13.6     13.1     12.6     12.2     11.8

  20 NUMBER INSTRUCTORS             13.3     12.2     11.3     10.6     10.0      9.5      9.1      8.7      8.4      8.1      7.9
```

Figure 19

```
FACULTY SALARY ANALYSIS REPORT               FACULTY SALARY ANALYSIS     SAMPLE COLLEGE  -  1          JANUARY 21 1970

     PLANNING ITEM                 1969      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979



  22 TOTAL FACULTY SALARY        691979    708029    719315    727977    734290    738439    705332    676791    651933    630088    610739

  23 TOTAL PROFESSORS SALARY     267950    267830    261351    249892    234103    214424    204810    196523    189305    182961    177343

  24 TOTAL ASSOCIATES SALARY     182102    187596    193630    200662    208515    217070    207338    198948    191640    185219    179531

  25 TOTAL ASSISTANTS SALARY     134197    146176    158661    171919    185903    200583    191590    183837    177085    171151    165895

  26 TOTAL INSTRUCTORS SALARY    107730    106425    105671    105503    105767    106362    101593     97482     93901     90755     87968

  27 AVERAGE FACULTY SALARY       10400     11601     12713     13741     14685     15546     15546     15546     15546     15546     15546

                                           DISTRIBUTION OF SALARY-RANK

  29 PROFESSOR                    142.0     157.3     170.6     182.2     192.5     201.6     201.6     201.6     201.6     201.6     201.6

  30 ASSOCIATE                    135.0     135.6     135.7     135.9     136.0     136.1     136.1     136.1     136.1     136.1     136.1

  31 ASSISTANT                    124.0     124.9     125.1     125.3     125.5     125.7     125.7     125.7     125.7     125.7     125.7

  32 INSTRUCTOR                   100.0     100.0     100.0     100.0     100.0     100.0     100.0     100.0     100.0     100.0     100.0
```

Figure 20

in any sequence. This flexibility allows the planner to create reports in the format that is suitable both to his specific planning needs and to the overall needs of his institution.

To illustrate the technique for designing a report, we will use the information presented in the second example, shown in Figure 14. To generate the first report, we enter the report title, "STUDENTS," and then specify lines 1, 2, and 4. For the second report, we enter the title, "FACULTY," and specify lines 5 through 8. The third report is called "INCOME" and includes lines 3 and 14. The last report, "EXPENSES," consists of lines 7, 9, 10, 13, and 12. Figure 21 shows how this report design input should be entered on the Summary Report Data Sheet. This design would produce each report on a separate page. Figure 22, for ease of examination, shows all of the output on a single page.

The ease of report design and the almost unlimited flexibility provided by the system enable the planner to produce reports ranging from broad general summaries of the entire planning model to detailed analyses of specific elements of particular concern. Because the report design is flexible, the planner can adapt the format to the unique requirements of his organization and he can change the emphasis of the report at any time, thus giving the report maximum usefulness in planning for the future.

SUMMARY REPORT DATA SHEET

MRI

Name
Project REPORT DESIGN EXAMPLE

TITLE	FREEFORM REPORT LINES	CONTINUE
STUDENTS	1, 2, 4	
FACULTY	5-8	
INCOME	3, 14	
EXPENSES	7, 9, 10, 13, 12	

Figure 21

```
SUMMARY REPORT              STUDENTS

    PLANNING ITEM                        BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

  1 STUDENTS                              800      823      848      874      900      927      955      983     1013     1043     1075
  2 FEES / STUDENT                        550      588      629      673      720      771      825      883      945     1011     1081
  4 STUDENT-FACULTY RATIO                23.0     22.0     21.0     20.0     19.0     18.0     18.0     18.0     18.0     18.0     18.0


SUMMARY REPORT              FACULTY

    PLANNING ITEM                        BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

  5 FACULTY                              -0.0     37.5     40.4     43.7     47.4     51.5     53.1     54.7     56.3     58.0     59.7
  6 AVERAGE FACULTY COMPENSATION        10500    10919    11356    11811    12283    12774    13285    13817    14369    14944    15542
  7 TOTAL FACULTY COMPENSATION              0   409003   458987   516251   582113   658202   705066   755267   809042   866646   928351
  8 DEPARTMENT EXPENSE/FACULTY          500.0    515.0    530.4    546.4    562.8    579.6    597.0    614.9    633.4    652.4    672.0


SUMMARY REPORT              INCOME

    PLANNING ITEM                        BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

  3 TOTAL FEE INCOME                        0   484923   534434   589000   649137   715414   788458   868959   957680  1055459  1163222
 14 NON-FEE INCOME                          0   278368   300991   326131   354645   387653   383291   374920   362021   344018   320265

SUMMARY REPORT              EXPENSES

    PLANNING ITEM                        BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

  7 TOTAL FACULTY COMPENSATION              0   409003   458987   516251   582113   658202   705066   755267   809042   866646   928351
  9 TOTAL DEPARTMENT EXPENSE                0    19289    21438    23881    26668    29864    31683    33613    35660    37831    40135
 10 ADMIN AND GEN EXPENSE              315000   335000   355000   375000   395000   415000   435000   455000   475000   495000   515000
 13 LIBRARY                                 0    38164    41771    45756    60226    66184    70305    74632    92379    97963   103844
 12 TOTAL G AND E EXPENSE                   0   763292   835426   915132  1003782  1103067  1171750  1243880  1319702  1399478  1483487
```

Figure 22

CHAPTER VI

GENERATING ALTERNATIVE PLANS: USE OF THE SYSTEM DRIVER

We have stated that the main advantage of simulation is that it permits planners to experiment, to answer the "what if...?" questions without actually manipulating the organization. Simulation enables the planner to examine various alternatives or combinations of alternatives and then to select the ones that appear best, or most likely, for actual implementation. With simulation, for example, the planners can see the results of a change in the student-faculty ratio without actually hiring (or firing) faculty members. In many such experiments it is often useful to consider precise values for certain items. For instance, what happens if the student-faculty ratio is 10 to 1, 12 to 1, 15 to 1, 18 to 1, or 20 to 1? In other cases, due to lack of precise data, it may not only be desirable but necessary to examine a range of values for certain planning items. For example, the interest on a loan that a college is considering taking out in 5 years may be anywhere from 5 to 8 percent; the planners have no way of knowing exactly what the interest rates will be in 5 years. In all cases there is a need for an efficient means for producing plans that incorporate the various alternatives.

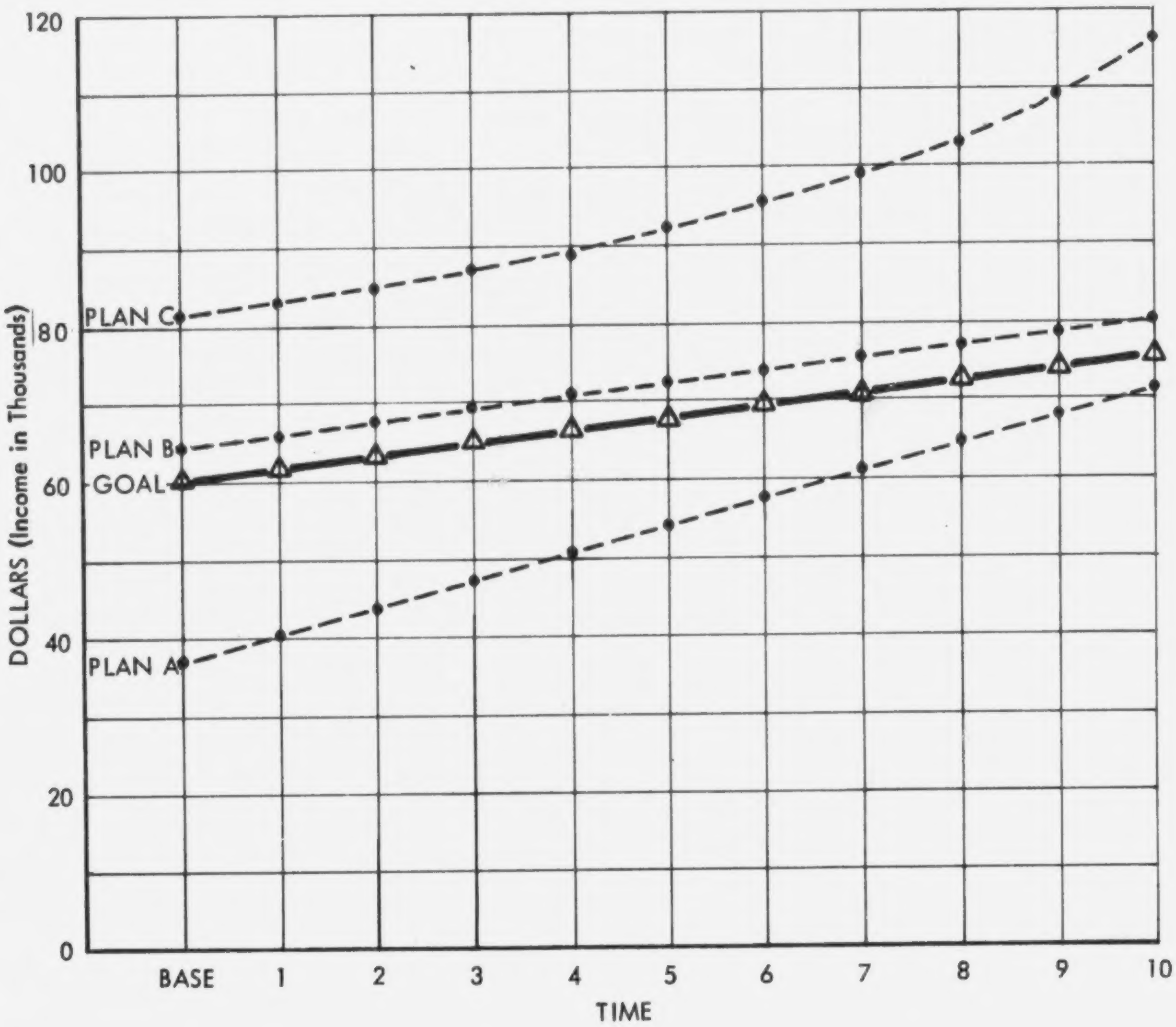
To satisfy this need simply and effectively, the PLANTRAN system uses a "system driver." It is called a system driver because it drives, or steps, the system through successive, planner-specified alternatives. This system capability works as follows: The base plan is entered and executed, generating the projections necessary to balance the total simulation equation. Next, the system reads change cards representing a different or alternative projection of a set of one or more planning items. The entire planning matrix is recomputed to bring the simulation equation back into balance, and the alternative plan is generated.

The computer handles each set of changes sequentially, and computes the associated plan. Since there is no limit to the number of changes that may be initiated, the planner may design an experiment to sweep through literally hundreds of alternatives, thus examining a large solution space for feasible alternatives.

Table I and Figure 23 illustrate the uses and benefits of the system driver. Table I shows the dollar values for the base period and each year of the 10-year planning horizon. The dollar values are given for the goal and for three alternative plans. Figure 23 is a graphical illustration relating dollars and time; the plotted lines show the values of each of the three alternative plans and the goal, or objective, values.

TABLE I

	Base ($)	Yr. 1 ($)	Yr. 2 ($)	Yr. 3 ($)	Yr. 4 ($)	Yr. 5 ($)	Yr. 6 ($)	Yr. 7 ($)	Yr. 8 ($)	Yr. 9 ($)	Yr. 10 ($)
GOAL VALUE	60,000	60,600	61,200	61,800	62,400	63,000	63,600	64,200	64,800	65,400	66,000
ALTERNATIVE A	37,500	39,950	42,300	44,750	47,200	49,650	52,100	54,550	57,000	59,450	61,900
ALTERNATIVE B	64,500	65,050	65,600	66,150	66,700	67,250	67,800	68,350	68,900	69,450	70,000
ALTERNATIVE C	81,500	83,375	85,250	87,125	89,000	92,250	95,750	99,500	103,000	109,750	116,500



GRAPH RELATING ALTERNATIVE PLAN VS. GOAL VALUES

Figure 23

(It should be noted that the normal system output is numeric; the graph here is for illustration.)

The graph in Figure 23 highlights the comparison process that the planner would follow in evaluating alternative plans. The goal line reflects the planner's knowledge of what can be realistically accommodated by the organization. The alternative lines show the computed effects of each of the alternatives. The planner may have changed several planning items to create an alternative. Such a technique enables the planner to learn more about the relationships between various planning components, experiment with several planning values to provide alternative solutions, and, then, compare the results with known objectives.

Use of the system driver in the PLANTRAN system is quite simple. The planner simply inserts cards reflecting his desired changes (the format is the same as the basic instruction input), and these cards replace the equivalent planning item line in the base model. Each instruction card that alters the plan must be followed by a "999" card (999 in card columns 1-3), and a card, or cards, denoting the desired report output (the format is the same as the summary report input). Next follows another "999" card, and, if desired, more change cards, a "999" card, report output cards, a "999" card, and so forth. Figure 24 shows the proper sequence of the data deck setup.

In using the system driver, it is important to note several things. First, the sequence of the change cards, a "999" card, the report output cards, a "999" card, etc., must be explicitly followed. Second, it must be kept in mind that from iteration to iteration the basic plan reflects the latest changes rather than the original plan values. If the planner desires the original value of a planning item rather than the current (latest) value, he must insert a change card restoring the original value. Third, the last "999" card must be followed by another "999" card denoting the end of the system run. Finally, the sequence of the computer printout must be understood. For the basic plan, a report titled "ANALYSIS OF PLANNING MATRIX" is printed. This report shows the line numbers, planning items, base values, code, method of computation, and total line, as well as the associated values for the entire planning horizon. Next comes the summary report, or reports, noting the planner-specified title, line numbers, base values, and planning horizon values. Then follows a description of the changes associated with the first iteration--ITERATION (n), a message, "THIS RUN CONTAINS CHANGES IN THE FOLLOWING INPUT LINES," a heading describing "LINE, CHANGE, BASE, CODE, METHOD OF COMPUTATION, ADD TO." Beneath this heading are printed the contents of the change cards.

The following pages will contain the summary reports requested and specified with the iteration. (Note that no "ANALYSIS OF PLANNING MATRIX" report is provided with the iterations.) The sequence of iteration information and summary report output is repeated until the end of the system run.

DATA DECK SETUP

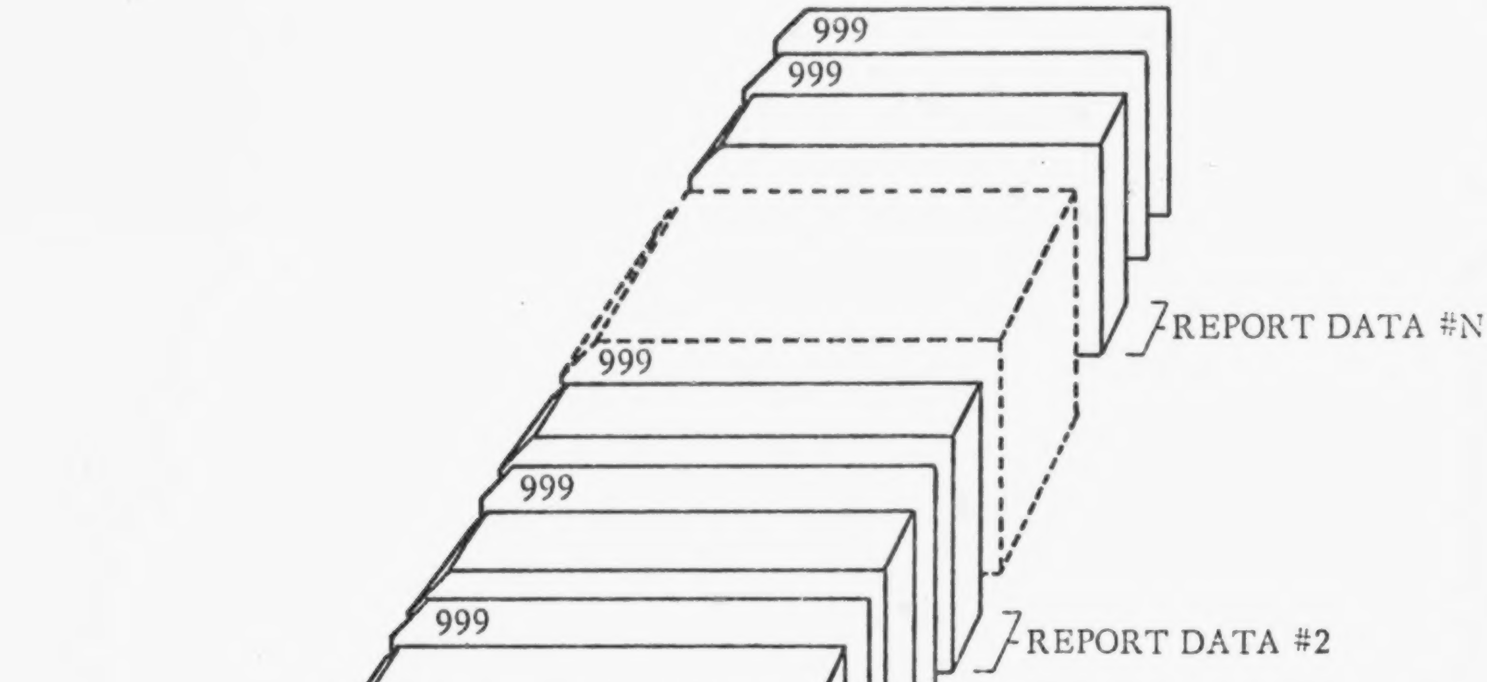

999
999
REPORT DATA #N
999
999
999
REPORT DATA #2
999
REPLACEMENT CARDS FOR 2ND ITERATION
999
REPORT DATA #1
999
REPLACEMENT CARDS FOR 1ST ITERATION
SUMMARY REPORT DATA
ID CARD
BASE DATA

Figure 24

In summary, the system driver provides the planner with a simple method of designing experiments to evaluate alternatives. This capability enhances the benefit to be derived from the simulation activity by facilitating the generation of alternative plans.

CHAPTER VII

SUMMARY

The planner can use the planning system we have described to experiment with virtually every aspect of the organization. Such experimentation will enable him to see the consequences of various alternative actions. Figure 25 shows the concept of a "plan refining cycle"--the iterative process that would be logically associated with the development of a long-range plan. By examination and evaluation of the system output, the elements indicating need for changes are identified, and modifications can be made to independent variable values or dependent variable relationships. Thus, by changing the base plan, making a computer run, and reviewing the output, the effects of a certain decision can be noted quickly and efficiently.

The use of the planning system provides the planner with an almost infinite number of alternatives in designing a model to represent his organization. However, the high degree of freedom in both model and report design requires that the objectives of the organization be used as a basis for the planning process. It is for that reason that a systematic means of applying knowledge of the organization--such as use of the outline of plans worksheet--must be used to insure inclusion of the desired objectives, knowledge, and level of detail and to define the operation of the organization most accurately.

Planning is a dynamic process; it must be responsive to frequent change. The current trends of growth and complexity in the administration of education demand that today's planning be more accurate, rapid, and extensive than ever before. This computerized planning system provides a tool to meet that need.

PLAN REFINING CYCLE

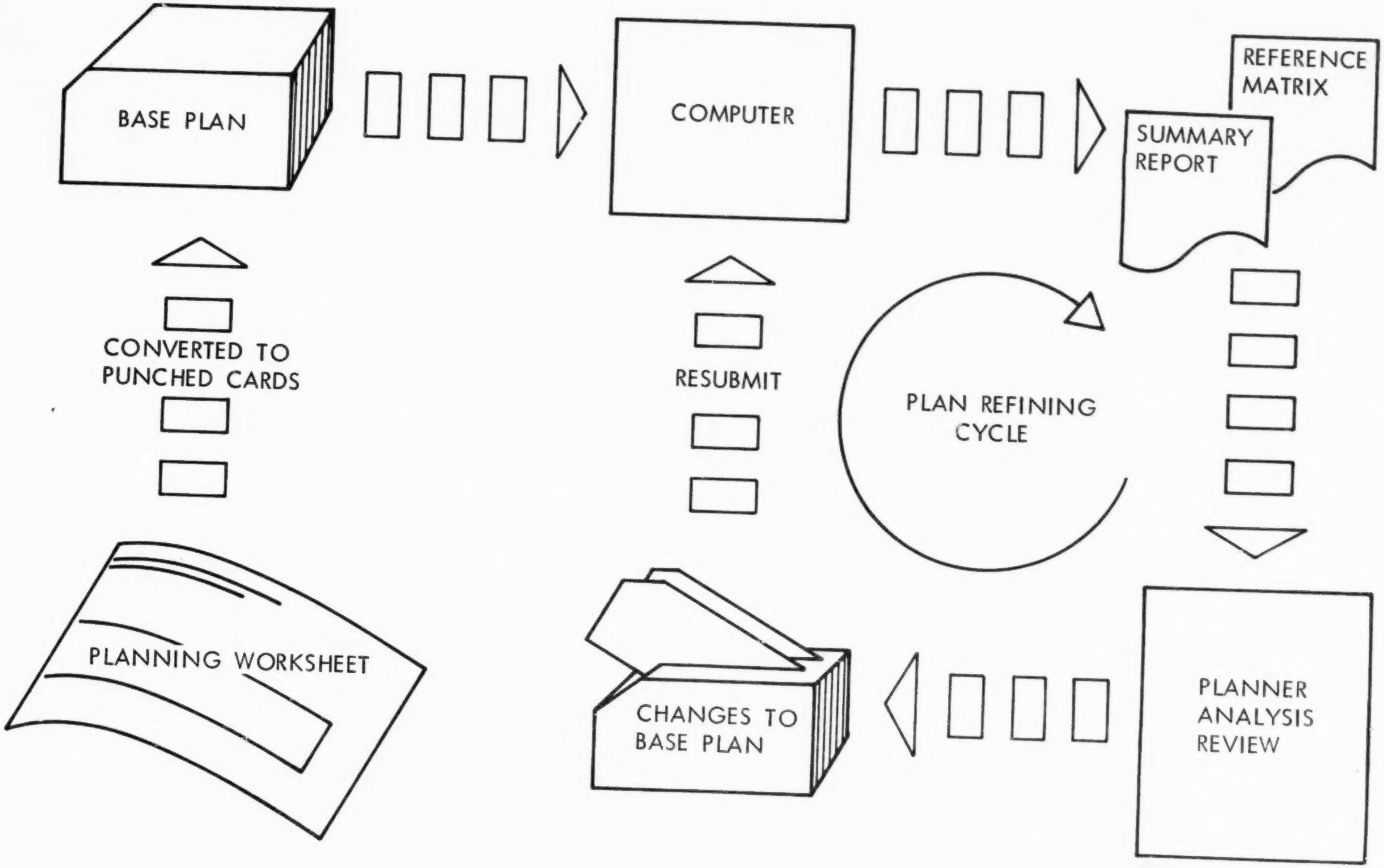

BASE PLAN
COMPUTER
REFERENCE MATRIX
SUMMARY REPORT
CONVERTED TO PUNCHED CARDS
RESUBMIT
PLAN REFINING CYCLE
PLANNING WORKSHEET
CHANGES TO BASE PLAN
PLANNER ANALYSIS REVIEW

Figure 25

APPENDIX A

PLANTRAN EXERCISES

PLANTRAN Exercises

The objective of these planning exercises is to provide the knowledge and skills required to design and manipulate organizational models using the PLANTRAN modeling language.

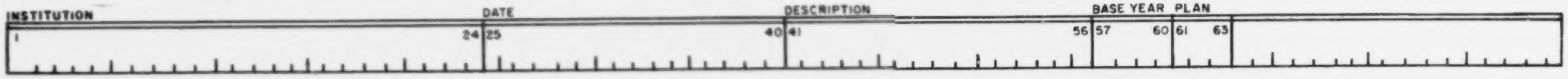
These sample exercises are provided to demonstrate the techniques used to identify the model, the instructions to project planning item values, and the specification for reports. Attention to the details of each of the techniques will enable one to understand the planning language concept and will aid in creating more meaningful models.

The exercises include examples of each PLANTRAN input format and all instructions in the language. The means of specifying a given instruction are flexible, varying from English-like statements to a very abbreviated code. We would urge that, at the start, the English-like statements be used to facilitate the learning process. As understanding of the language develops, the instruction statements may be abbreviated.

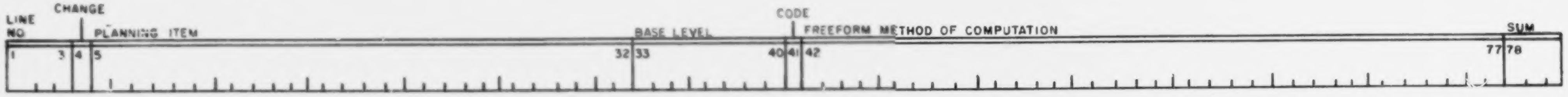
The answers to the exercises are found on the page following the individual exercise. Note that all the possible answers are not provided, only a sample of the various statements that will generate the correct identification, instruction, or report information. In addition, a sample program output relating to the exercise is provided beneath the sample answers.

* * PLANTRAN Language Input Formats * *

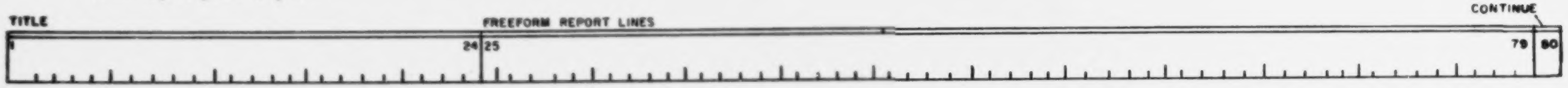
Identification Input—


INSTITUTION
DATE
DESCRIPTION
BASE YEAR
PLAN
1
24
25
40
41
56
57
60
61
63

Instruction Input—


LINE NO.
CHANGE
PLANNING ITEM
BASE LEVEL
CODE
FREEFORM METHOD OF COMPUTATION
SUM
1
3
4
5
32
33
40
41
42
77
78

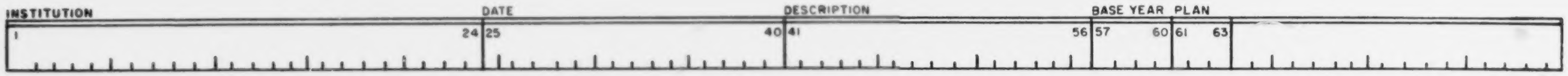
Summary Report Input—


TITLE
FREEFORM REPORT LINES
CONTINUE
1
24
25
79
80

* *

EXERCISE 1

Using the Plan Identification Data Sheet (below), provide the input data for: Sample College; the current date; Overview Model as a description; 1969 as the base year; and indication that this is the first plan.


INSTITUTION
DATE
DESCRIPTION
BASE YEAR
PLAN
1
24
25
40
41
56
57
60
61
63

SAMPLE ANSWER--EXERCISE 1

INSTITUTION	DATE	DESCRIPTION	BASE YEAR	PLAN	
1 24	25 40	41 56	57 60	61 63	
SAMPLE COLLEGE	CURRENT DATE	OVERVIEW MODEL	1969	1	

```
           REPORT              SAMPLE COLLEGE          OVERVIEW MODEL -  1          CURRENT DATE

PLANNING ITEM              1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
.....................................................................................................................
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 2

Provide the identification data for: your own, or any college; any date; any description; a base year such that the years 1972 through 1981 are included in the planning horizon; and a plan number of 45.

INSTITUTION	DATE	DESCRIPTION	BASE YEAR	PLAN	
1 24	25 40	41 56	57 60	61 63	

SAMPLE ANSWER--EXERCISE 2

INSTITUTION 1–24	DATE 25–40	DESCRIPTION 41–56	BASE YEAR 57–60	PLAN 61–63	
ANY COLLEGE	ANY DATE	ANY DESCRIPTION	1971	45	

```
                  REPORT                         ANY COLLEGE                    ANY DESCRIPTION- 45          ANY DATE

   PLANNING ITEM                   1971      1972      1973      1974      1975      1976      1977      1978      1979      1980      1981
.............................................................................................................................................
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 3

Using the Instruction Data Sheet (below), enter the instruction to create a planning item with: a line number of 5; a name of Freshman; a base level of 300; a code to indicate change by a percentage; a percentage value of 3.5 percent; and to be totaled into line 9 (Total Enrollment).

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 3

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78
5		FRESHMAN	300.	2	CHANGE BY 3.5 % PER PERIOD	9
5		FRESHMAN	300.	2	INCREASE BY 3.5 PERCENT PER PERIOD	9
5		FRESHMAN	300.	2	INCR 3.5%/PR	9
5		FRESHMAN	300.	2	I 3.5	9
5		FRESHMAN	300.	2	3.5	9

```
   PLANNING ITEM                 1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
..............................................................................................................................

 5  FRESHMAN                     300.0    310.5    321.4    332.6    344.3    356.3    368.8    381.7    395.0    408.9    423.2
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 4

Provide the data to specify a planning item with: a line number of 7; called Special Students: denoting a decreasing percentage change of 5 percent; and a current level of 46.

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78

SAMPLE ANSWERS--EXERCISE 4

LINE NO. 1-3	CHANGE 4	PLANNING ITEM 5-32	BASE LEVEL 33-40	CODE 41	FREEFORM METHOD OF COMPUTATION 42-77	SUM 78
7		SPECIAL STUDENTS	46.	2	CHANGE BY -5% PER PERIOD	
7		SPECIAL STUDENTS	46.	2	DECREASE 5.0 % PER PERIOD	
7		SPECIAL STUDENTS	46.	2	DECR 5. PERCENT / PR	
7		SPECIAL STUDENTS	46.	2	D 5	
7		SPECIAL STUDENTS	46.	2	-5	

```
  PLANNING ITEM                1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.........................................................................................................................

7 SPECIAL STUDENTS             46.0    43.7    41.5    39.4    37.5    35.6    33.8    32.1    30.5    29.0    27.5
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 5

Using the Instruction Data Sheet (below), enter the instruction to create a planning item with: a line number of 35; a planning item name of Professors; a base level of 30; a code to show change by an increment; a change of 2 per year; and to be totaled in line 39 (Total Faculty).

LINE NO 1-3	CHANGE 4	PLANNING ITEM 5-32	BASE LEVEL 33-40	CODE 41	FREEFORM METHOD OF COMPUTATION 42-77	SUM 78

SAMPLE ANSWERS--EXERCISE 5

LINE NO	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1 3	4	5 32	33 40	41	42 77	78
35		PROFESSORS	30.	3	CHANGE BY 2 PER PERIOD	39
35		PROFESSORS	30.	3	INCREASE +2. PER PERIOD	39
35		PROFESSORS	30.	3	INCR 2/PR	39
35		PROFESSORS	30.	3	I,2	39
35		PROFESSORS	30.	3	2	39

```
   PLANNING ITEM               1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.............................................................................................................
35  PROFESSORS                 30.0    32.0    34.0    36.0    38.0    40.0    42.0    44.0    46.0    48.0    50.0
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 6

Provide the data to generate the planning item called Freshman; line number 5; base level of 300; an increase of 10 per year; and totaled on line 11 (Total Students).

LINE NO	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1 3	4	5 32	33 40	41	42 77	78

SAMPLE ANSWERS--EXERCISE 6

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78
5		FRESHMAN	300.	3	CHANGE BY 10 PER PERIOD	11
5		FRESHMAN	300.	3	INCREASE BY 10.0 / PERIOD	11
5		FRESHMAN	300.	3	INCR 10/PR	11
5		FRESHMAN	300.	3	I,10	11
5		FRESHMAN	300.	3	10	11

```
PLANNING ITEM               1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
..........................................................................................................................
5  FRESHMAN                300.0   310.0   320.0   330.0   340.0   350.0   360.0   370.0   380.0   390.0   400.0
```

* *

EXERCISE 7

Provide the instruction to generate a planning item called Student-Faculty Ratio; a line number of 9; a base to reflect a 16:1 current value; a code to show change to a goal level; a goal value of 20:1; and the goal to be achieved in 4 years.

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78

SAMPLE ANSWERS--EXERCISE 7

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
9		STUDENT-FACULTY RATIO	16.	4	CHANGE TO 20 IN P4 PERIOD	
9		STUDENT-FACULTY RATIO	16.	4	INCREASE TO +20. IN P4	
9		STUDENT-FACULTY RATIO	16.	4	INCR 20 P4	
9		STUDENT-FACULTY RATIO	16.	4	I 20. P4	
9		STUDENT-FACULTY RATIO	16.	4	20. P4	

```
  PLANNING ITEM                  1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.........................................................................................................................
9  STUDENT-FACULTY RATIO         16.0    17.0    18.0    19.0    20.0    20.0    20.0    20.0    20.0    20.0    20.0
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 8

Provide the data to create an Average Faculty Salary planning item; with a line number of 23; a change ID number of 2; a current level of 10500; and a goal of 13750 to be reached in 5 years.

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 8

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
23	2	AVERAGE FACULTY SALARY	10500.	4	CHANGE TO 13750 IN P5 PERIOD	
23	2	AVERAGE FACULTY SALARY	10500.	4	INCREASE TO 13750. IN P 5	
23	2	AVERAGE FACULTY SALARY	10500.	4	INCREASE 13750. P5	
23	2	AVERAGE FACULTY SALARY	10500.	4	I, 13750 P5	
23	2	AVERAGE FACULTY SALARY	10500.	4	13750 P5	

```
PLANNING ITEM                1969   1970   1971   1972   1973   1974   1975   1976   1977   1978   1979
...........................................................................................................
23  AVERAGE FACULTY SALARY   10500  11150  11800  12450  13100  13750  13750  13750  13750  13750  13750
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 9

Provide the input data to generate a planning item called Fees; with a line number of 31; a base level of 125; a code to show insertion of constant data; with constant values of 150 for years 1-4, 175 for years 5-8, and 200 for years 9-10; and to be totaled on line 40 (Total Student Expenses).

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 9

LINE NO. 1-3	CHANGE 4	PLANNING ITEM 5-32	BASE LEVEL 33-40	CODE 41	FREEFORM METHOD OF COMPUTATION 42-77	SUM 78
31		FEES	125.	5	150,150,150,150,175.,175.,175.,C	40
					175.,200, 200	
31		FEES	125.	5	150 , 150. , 150 , 150. , C	40
					175 , 175, 175, 175, C	
					200. , 200	

```
  PLANNING ITEM                  1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
.............................................................................................................................
31  FEES                        125.0    150.0    150.0    150.0    150.0    175.0    175.0    175.0    175.0    200.0    200.0
```

* *

EXERCISE 10

Generate a planning item called Debt Reduction; line number 75; a base value of 50000; and with values of 60000 for years 1-3 and 70000 for years 6-10.

LINE NO. 1-3	CHANGE 4	PLANNING ITEM 5-32	BASE LEVEL 33-40	CODE 41	FREEFORM METHOD OF COMPUTATION 42-77	SUM 78

SAMPLE ANSWERS--EXERCISE 10

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
75		DEBT REDUCTION	50000.	5	60000, 60000, 60000, , , 70000, C	
					70000 , 70000, 70000, 70000	
75		DEBT REDUCTION	50000.	5	60000,60000,60000,,,70000,70000, C	
					70000,70000,70000	

```
PLANNING ITEM                1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
..............................................................................................................
75  DEBT REDUCTIO            50000   60000   60000   60000      0       0   70000   70000   70000   70000   70000
```

* *

EXERCISE 11

Write the instruction data to create a planning item called Total Student Expenses; a code to show that it is summed from other lines; a line number of 40; and note that lines 31, 33, 35, and 37 are totaled in the summary.

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 11

LINE NO (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78)
40		TOTAL STUDENT EXPENSES		1	SUMMARY OF LINES 31, 33, 35, AND 37	
40		TOTAL STUDENT EXPENSES		1	TOTAL OF 31, 33, 35, 37	
40		TOTAL STUDENT EXPENSES		1		

```
   PLANNING ITEM                1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.......................................................................................................................
31  TUITION-FEES PER YEAR       1000    1100    1200    1300    1400    1500    1600    1700    1800    1900    2000

33  ROOM-BOARD PER YEAR          800     850     900     950    1000    1050    1100    1150    1200    1250    1300

35  BOOKS-SUPPLIES PER YEAR    150.0   162.0   175.0   189.0   204.1   220.4   238.0   257.1   277.6   299.9   323.8

37  ACTIVITY TICKETS            25.0    26.2    27.6    28.9    30.4    31.9    33.5    35.2    36.9    38.8    40.7

40 TOTAL STUDENT EXPENSES          0    2138    2302    2467    2634    2802    2971    3142    3314    3488    3664
```

* *

EXERCISE 12

Provide the data for a line number 39; called Total Faculty; a base value of 143; including the sum of lines 35, 36, 37, and 38; and to be totaled in line 65 (Total Employees).

LINE NO (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78)

SAMPLE ANSWERS--EXERCISE 12

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
39		TOTAL FACULTY	143.	1	SUMMARY OF LINES 35, 36, 37, AND 38	65
39		TOTAL FACULTY	143.	1	TOTAL OF 35, 36, 37, 38	65
39		TOTAL FACULTY	143.	1		65

	PLANNING ITEM	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
35	FULL PROFESSORS	33.0	31.7	30.3	29.0	27.7	26.3	25.0	25.0	25.0	25.0	25.0
36	ASSOCIATE PROFESSORS	27.0	28.1	29.2	30.4	31.5	32.6	33.8	34.9	36.0	36.0	36.0
37	ASSISTANT PROFESSORS	41.0	40.0	39.0	38.0	37.0	36.0	35.0	34.0	33.0	32.0	31.0
38	INSTRUCTORS	42.0	39.9	37.7	35.6	33.5	31.4	29.2	27.1	25.0	25.0	25.0
39	TOTAL FACULTY	143.0	139.7	136.3	133.0	129.7	126.3	123.0	121.0	119.0	118.0	117.0

* * * * * * * * * * * * * * * * * * * *

EXERCISE 13

Furnish the data for a planning item called Faculty; a line number of 42; a code to show the item is a function of other variables; and to be computed by dividing line 14 (Student-Faculty Ratio) into line 23 (Total Students).

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 13

LINE NO. 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
42		FACULTY		6	L 23 / L14	
42		FACULTY		6	L23/L14	

```
   PLANNING ITEM                1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.....................................................................................................................

14 STUDENT-FACULTY RATIO        14.2    14.8    15.4    16.0    16.0    16.0    16.0    16.0    16.0    16.0    16.0

23 TOTAL STUDENTS                779     798     827     863     906     949     991    1034    1077    1119    1162

42 FACULTY                      -0.0    53.9    53.7    53.9    56.6    59.3    61.9    64.6    67.3    69.9    72.6
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 14

Enter a planning item with a line number of 54; called Department Expense; with a base level of 12500; computed by multiplying .01 times line 50 (Department Expense as Percent G & E and multiplying the product times line 52 (G & E Expense).

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 14

LINE NO 1-3	CHANGE 4	PLANNING ITEM 5-32	BASE LEVEL 33-40	CODE 41	FREEFORM METHOD OF COMPUTATION 42-77	SUM 78
54		DEPARTMENT EXPENSE	12500.	6	.01 L50 * L52	
54		DEPARTMENT EXPENSE	12500.	6	.01L50*L52	

```
   PLANNING ITEM                      1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
......................................................................................................................................

 50  DEPT EXPENSE AS PERCENT G+F     12.5     13.4     14.3     15.2     16.2     17.1     18.0     18.0     18.0     18.0     18.0

 52  G + F EXPENSE                 100000   110000   120000   130000   140000   150000   160000   170000   180000   190000   200000

 54  DEPARTMENT EXPENSE             12500    14758    17199    19824    22633    25624    28793    30599    32399    34199    35999
```

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EXERCISE 15

Provide a planning item called Tuition; a line number of 34; a code denoting maximum of other planning items; which is derived from scanning lines 32 and 33 (Tuition Plan A and Tuition Plan B), which is the maximum of the two lines; and to be totaled on line 64 (Student Expenses).

LINE NO 1-3	CHANGE 4	PLANNING ITEM 5-32	BASE LEVEL 33-40	CODE 41	FREEFORM METHOD OF COMPUTATION 42-77	SUM 78

SAMPLE ANSWERS--EXERCISE 15

LINE NO. 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78
34		TUITION		8	MAX OF 32,33	64
34		TUITION		8	MAX 32,33	64
34		TUITION		8	A 32,33	64

```
   PLANNING ITEM          1969   1970   1971   1972   1973   1974   1975   1976   1977   1978   1979
.......................................................................................................
32 TUITION PLAN A         1000   1080   1160   1240   1320   1400   1480   1560   1640   1720   1800
33 TUITION PLAN B         1000   1120   1240   1360   1480   1600   1600   1600   1600   1600   1600
34 TUITION                1000   1120   1240   1360   1480   1600   1600   1600   1640   1720   1800
```

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EXERCISE 16

Create a planning item called Instructor's Salary; with a line number of 38, which is determined by examining lines 27 and 28 (Instructor and Instructor Check Line); and generating the minimum of the two lines.

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78

SAMPLE ANSWERS--EXERCISE 16

LINE NO. 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
38		INSTRUCTOR'S SALARY		B	MIN OF 27,28	
38		INSTRUCTOR'S SALARY		B	MIN 27, 28	
38		INSTRUCTOR'S SALARY		B	I 27,28	

```
    PLANNING ITEM                1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
......................................................................................................................

 27 INSTRUCTOR                   8100    8585    9101    9647   10226   10839   11490   12179   12910   13684   14505
 28 INSTRUCTOR CHECK LINE        8100    8514    8928    9342    9757   10171   10585   11000   11000   11000   11000
 38 INSTRUCTOR SALARY            8100    8514    8928    9342    9757   10171   10585   11000   11000   11000   11000
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 17

Provide the data for a line called Cum Operating Surplus; a line number of 86; a base value of 123750; and to be the accumulative sum of line 85 (Operating Surplus).

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 17

LINE NO. (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78)
86		CUM OPERATING SURPLUS	123750.	9	SUM OF LINE 85	
86		CUM OPERATING SURPLUS	123750.	9	SUM OF 85	
86		CUM OPERATING SURPLUS	123750.	9	SUM 85	
86		CUM OPERATING SURPLUS	123750.	9	S,85	

```
   PLANNING ITEM                     1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

85  OPERATING SURPLUS              123750    24127    16311     8460     2533     4261     5375     9123    11246     9746     6245

86  CUM OPERATING SURPLUS          123750   147877   164188   172648   175181   179442   184817   193940   205186   214932   221177
```

* *

EXERCISE 18

Enter the input data for a planning item with a line number of 58; a name of Product Line; a base value of 2.5; and to be the accumulative product of line 55 (Formula).

LINE NO. (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78)

SAMPLE ANSWERS--EXERCISE 18

LINE NO. 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78
58		PRODUCT LINE	2.5	9	PROD OF LINE 55	
58		PRODUCT LINE	2.5	9	PROD OF 55	
58		PRODUCT LINE	2.5	9	PROD 55	
58		PRODUCT LINE	2.5	9	P,55	

```
   PLANNING ITEM              1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.................................................................................................................
55 FORMULA                     2.5     2.4     2.3     2.2     2.1     2.0     1.9     1.8     1.7     1.6     1.5

58 PRODUCT LINE                  2       6      13      30      63     127     242     436     741    1136    1779
```

* *

EXERCISE 19

Show the input for a planning item with a line number of 7; called Potential Sophomore; a base level of 290; a code to denote the last year's value of another planning item; and to be derived by taking line number 6 (Freshman) and shifting the data one period.

LINE NO 1–3	CHANGE 4	PLANNING ITEM 5–32	BASE LEVEL 33–40	CODE 41	FREEFORM METHOD OF COMPUTATION 42–77	SUM 78

SAMPLE ANSWERS--EXERCISE 19

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1 3	4	5 32	33 40	41	42 77	78
7		POTENTIAL SOPHOMORE	238.	7	SHIFT 1. OF L6	
7		POTENTIAL SOPHOMORE	238.	7	SHIFT L6	
7		POTENTIAL SOPHOMORE	238.	7	L6	

```
   PLANNING ITEM              1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
...............................................................................................................

6  FRESHMAN                  300.0   310.0   320.0   330.0   340.0   350.0   360.0   370.0   380.0   390.0   400.0

7  POTENTIAL SOPHOMORES      290.0   300.0   310.0   320.0   330.0   340.0   350.0   360.0   370.0   380.0   390.0
```

* *

EXERCISE 20

Provide a planning item called Junior; line number 8; determined by taking .65 times line 7 (Sophomore), shifted one period; and to be totaled on line 10 (Total Students).

LINE NO	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1 3	4	5 32	33 40	41	42 77	78

87

SAMPLE ANSWERS--EXERCISE 20

LINE NO (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78)
8		JUNIOR		7	.65 DIAGONAL L7	10
8		JUNIOR		7	SHIFT .65 TIMES L7	10
8		JUNIOR		7	.65L7	10

```
PLANNING ITEM          1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
..........................................................................................................
7  SOPHOMORE          234.0   237.1   241.9   246.7   251.7   256.7   261.6   267.1   272.4   277.9   283.4
8  JUNIOR             150.0   154.7   154.1   157.2   160.4   163.6   166.2   170.2   173.6   177.1   180.6
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 21

Provide the input for a line number 87; named Summary Information; a code to denote that the planning item is a heading.

LINE NO (1–3)	CHANGE (4)	PLANNING ITEM (5–32)	BASE LEVEL (33–40)	CODE (41)	FREEFORM METHOD OF COMPUTATION (42–77)	SUM (78)

SAMPLE ANSWER--EXERCISE 21

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78
87		SUMMARY INFORMATION				

```
PLANNING ITEM                    1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
.....................................................................................................................
                             SUMMARY INFORMATION
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 22

Provide the input data for a heading with a line number of 27; a name of Faculty Information.

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78

SAMPLE ANSWER--EXERCISE 22

LINE NO 1 3	CHANGE 4	PLANNING ITEM 5 32	BASE LEVEL 33 40	CODE 41	FREEFORM METHOD OF COMPUTATION 42 77	SUM 78
27		FACULTY INFORMATION				

```
PLANNING ITEM                  1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
...............................................................................................................................

                                            FACULTY INFORMATION
```

* * * * * * * * * * * * * * * * * * * *

EXERCISE 23

Using the Summary Report Data Sheet (below), provide the input to create four summary reports: Students, using lines 1, 2, and 4; Faculty, using lines 5, 6, 7, and 8; Income, using lines 3 and 14; and Expenses, using lines 7, 9, 10, 13, and 12.

TITLE 1 24	FREEFORM REPORT LINES 25 79	CONTINUE 80

SAMPLE ANSWER--EXERCISE 23

TITLE	FREEFORM REPORT LINES	CONTINUE
STUDENTS	1,2,4	
FACULTY	5-8	
INCOME	3,14	
EXPENSES	7,9,10,13,12	

NOTE:

The summary reports generated by the above statements are shown on the following page. For the sample, each of the four reports is combined onto a single page. The actual system output would separate each report specified by a unique Summary Report Input statement and print it on a page, or pages, as required. This ability to specify unique reports relating to a certain aspect of planning enables the planner to create reports appropriate to his needs.

* *

```
SUMMARY REPORT            STUDENTS

   PLANNING ITEM                     BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

 1 STUDENTS                           800      823      848      874      900      927      955      983     1013     1043     1075
 2 FEES / STUDENT                     550      588      629      673      720      771      825      883      945     1011     1081
 4 STUDENT-FACULTY RATIO             23.0     22.0     21.0     20.0     19.0     18.0     18.0     18.0     18.0     18.0     18.0

SUMMARY REPORT            FACULTY

   PLANNING ITEM                     BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

 5 FACULTY                           -0.0     37.5     40.4     43.7     47.4     51.5     53.1     54.7     56.3     58.0     59.7
 6 AVERAGE FACULTY COMPENSATION     10500    10919    11356    11811    12283    12774    13285    13817    14369    14944    15542
 7 TOTAL FACULTY COMPENSATION           0   409003   458987   516251   582113   658202   705066   755267   809042   866646   928351
 8 DEPARTMENT EXPENSE/FACULTY       500.0    515.0    530.4    546.4    562.8    579.6    597.0    614.9    633.4    652.4    672.0

SUMMARY REPORT            INCOME

   PLANNING ITEM                     BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

 3 TOTAL FEE INCOME                     0   484923   534434   589000   649137   715414   788458   868959   957680  1055459  1163222
14 NON-FEE INCOME                       0   278368   300991   326131   354645   387653   383291   374920   362021   344018   320265

SUMMARY REPORT            EXPENSES

   PLANNING ITEM                     BASE     YR 1     YR 2     YR 3     YR 4     YR 5     YR 6     YR 7     YR 8     YR 9     YR10

 7 TOTAL FACULTY COMPENSATION           0   409003   458987   516251   582113   658202   705066   755267   809042   866646   928351
 9 TOTAL DEPARTMENT EXPENSE             0    19289    21438    23881    26668    29864    31683    33613    35660    37831    40135
10 ADMIN AND GEN EXPENSE           315000   335000   355000   375000   395000   415000   435000   455000   475000   495000   515000
13 LIBRARY                              0    38164    41771    45756    60226    66184    70305    74632    92379    97963   103844
12 TOTAL G AND E EXPENSE                0   763292   835426   915132  1003782  1103067  1171750  1243880  1319702  1399478  1483487
```

APPENDIX B

SAMPLE COLLEGE MODEL

SAMPLE COLLEGE MODEL

This appendix is provided to give an example of a model for an institution. The brief description of "Sample College" is followed by the Planning Simulator System input statements. The Summary Report output follows, and finally, the Analysis of Planning Matrix Report.

A review of this appendix should give the planner an understanding of the levels of detail associated with model design.

SAMPLE COLLEGE

Sample College was founded in 1864. From its early beginning of four teachers and nine students, Sample College has grown to its present faculty of 50 and a total enrollment of 779. It is the intent of the faculty and administration to continue to grow to about 1,000 students in the next 6 years, and onward at about that same rate. This growth will be accomplished by increasing the size of the entering freshman class by 15 students each year, a goal which appears reasonable to the Admissions office.

Dormitory residents now number 615, or 79 percent of the total head count. Due to the increasing tendency of Sample College students to provide their own housing off campus, and due to the decreasing popularity of dormitory-living, the college anticipates that as the enrollment increases, the percentage of students who will be living in dormitories will decrease to 70 percent over the 10-year period. The present ratio of 60 percent men, 40 percent women residents is expected to continue. Since the college now has residence hall capacity of about 650, there will be a need for additional dormitory facilities in about 5 years.

The costs of operating the college will continue to rise, though the college cannot say exactly how much. However, the college tentatively anticipates raising the tuition charge from its present level of $1,000 per year to a level of $2,000 per year over the 10-year period, going up in increments of $100 each year. Some of the faculty point out that Sample College is a good college, which has traditionally served the youth from its state, "Midwest," and that it is cruel to raise the charges so steeply. The Trustees claim that if the college is as good as it thinks it is, the college should charge as much as other schools of the same caliber, some of which are already at $2,000 per year. The present anticipated increase of $100 per year is a tentative compromise figure. An increase in room and board of $50 per year and an increase of books and supplies of 8 percent a year are considered sufficient to keep up with market conditions.

The 50 faculty members are distributed among the ranks with 16 (32 percent) as instructors, 14 (28 percent) as assistant professors, 9 (18 percent) as associate professors, and 11 (22 percent) as full professors. As the student body increases, the college anticipates changing from its present 14.2 students per faculty member to 16.0 over a period of 3 years. This will cause a slight drop in the total number of faculty positions in the next 2 years, but then will increase to 66 positions in the 10th year.

The levels of faculty compensation are adequate for the area, the overall average now being $9,400. The college plans on increasing this figure to $16,500 over the 10-year period. Fringe benefits now represent 8.5 percent of salaries and are expected to increase to 15 percent in the 10-year period.

The average credit-hour load per faculty member is currently 14.0 hours per semester. In response to repeated suggestions from a faculty committee, the college hopes to drop this credit hour load to a 10-hour load over a period of 6 years. The combined effect of reducing teaching loads over a period of 6 years and increasing the student-faculty ratio over a period of 3 years is indicated in the resulting average class size. That figure is currently 15.2 students per class, will increase to 20.0 in 3 years, then will continue to increase, at a somewhat slower rate, to 24.0 over the following 3 years.

The average class size, incidentally, is calculated by relating four other figures: the average student load, the full-time equivalent number of students, the average faculty load, and the full-time equivalent faculty. The formula is:

$$\frac{\text{students X load}}{\text{faculty X load}} = \frac{\text{hours earned}}{\text{hours taught}} = \text{average class size}$$

The Sample College Library presently holds 43,000 volumes. The college is assuming that these holdings will increase approximately three volumes per FTE student each year. This will result in library holding of slightly more than 69,000 volumes at the end of the 10-year period. The 200 periodical subscriptions are considered to be inadequate, so the college anticipates increasing the periodical list to 500 titles over the next 7 years. The cost of books now averages $8 per volume, but appears to be increasing at about 6 percent per year. The periodical cost is now $14 per title, and is expected to increase by about 10 percent per year. A cost figure for administration and services of the library appears to equal 75 cents per volume held plus $5 per student. This is the basis for calculating the library budget.

Income Budget

To account for attrition between semesters and other variations and changes, the fee income is calculated by multiplying annual fees times fall FTE enrollment, then taking 96 percent of the resulting figure. This formula has been fairly consistent over the past 3 years.

Endowment income is presently only $3,750, but with a new and energetic staff man in the development office, the college believes that this income can be increased to $100,000 per year. This means that the endowment portfolio will have to increase from its present $75,000 to $2,000,000.

Gifts and grants for general operations currently amount to $112,049, and can reasonably be expected to increase by 10 percent per year. Other income is anticipated to increase at a modest 5 percent per year.

Residence hall income is calculated by taking residence hall fee times the number of resident students. Although there is some attrition between semesters, this is generally balanced by guest charges and the use of residence halls for some summer conferences.

Bookstore income results from books and supplies times the number of FTE students. Although not all of the students' money for books and supplies is spent at the bookstore, neither is all the bookstore income generated by students. Faculty purchases, some office supplies, and alumni and visitor souvenir purchases make up the difference.

The student aid income has two sources, one being the endowed aid, which can be expected to increase by 10 percent per year, and the second being the special gifts, which, through special appeals, are expected to increase by 15 percent per year. The endowment portfolio for student aid currently stands at $1,074,200 and will have to be increased to $2,786,198 if the 10 percent per year income increase is reasonable.

Expense Budget

At present the expense figures for college-wide operations are expected to increase at the following rates:

	Percent Increase
General administration	4
Student services	7
Public relations	6
General institutional expense	3
Plant operation and maintenance	5

The budgets for instruction and the library were calculated on specific program data, detailed above.

Expenses for residence halls and the bookstore are expected to represent 90 percent and 83 percent of the income for those items, showing an operating surplus.

The income for financial aid is added to the operating surplus for auxiliary enterprises to make up the amount available for student financial aid expense.

Analyses

The most obvious analysis is to compare the total current income with the total current expense. This currently yields a loss of $534,454, expressed as a negative surplus. To learn the long-range effects of the projections and assumptions detailed above, the figures for operating surplus are accumulated throughout the 10-year period to a total of -$5,918,281.

Another type of analysis is to indicate the percent of the educational and general budget represented by the various components. Thus, we can see that based on the projections, instruction can be expected to climb from its present 38.5 percent to an eventual 59.4 percent of a total budget. The library will go from its present 3.5 percent to a high of 4.1 percent then drop to 4.0 percent. At no time, however, would the library be receiving the level of support recommended by the National Library Association or the accrediting agencies.

Student fees are currently supplying just half the total educational and general budget; according to the assumptions and projections, they will be paying two-thirds of the budget in the 10th year.

The calculations also show that financial aid expense represents 22.6 percent of student fees, but will decrease to about 19 or 20 percent over the planning period. This means that even though the college is increasing both the costs per student and the number of students, financial aid is keeping about even with its present level of support.

The figures for general and financial aid endowment funds are based on the desired results, indicated above, and the assumption that they represent a 5 percent income.

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Name ______________________

Project ____________

PLAN IDENTIFICATION DATA SHEET

MRI

5 10 15 20 25 30 35 45 50 55 60 65 70 75 80

INSTITUTION	DATE	DESCRIPTION	BASE YEAR	PLAN	
1 SAMPLE COLLEGE 24	25 CURRENT DATE 40	41 OVERALL MODEL 56	57 1969 60	61 1 63	

INSTRUCTION DATA SHEET

MRI

Name ______________________

Project ______________

5 10 15 20 25 30 35 45 50 55 60 65 70 75 80

LINE NO	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
1		STUDENTS				
2		FRESHMEN FALL HEAD COUNT	300.	3	INCREASE BY 15 PER YEAR	13
3		POTENTIAL SOPH		7	DIAGONAL OF LINE 2	
4		PCT RENENTION FR-SOPH	60.	2	INCREASE 0. PERCENT PER YEAR	
5		SOPHOMORES FALL HEAD COUNT	180.	6	L3 * .01 L4	13
6		POTENTIAL JRS		7	DIAGONAL OF LINE 5	
7		PCT RETENTION SOPH-JR	80.	2	INCREASE 0. PERCENT PER YEAR	
8		JUNIORS FALL HEAD COUNT	144.	6	L6 * .01 L7	13
9		POTENTIAL SENIORS		7	DIAGONAL OF LINE 8	
10		PCT RETENTION JR-SR	90.	2	INCREASE 0. PERCENT PER YEAR	
11		SENIORS FALL HEAD COUNT	130.	6	L9 * .01 L10	13
12		SPECIAL AND UNCLASSIFIED	25.	3	INCREASE 5 PER YEAR	13
13		TOTAL FALL HEAD COUNT	799.	1		
14		FULL TIME	660.	6	.85 L13	17
15		PART TIME	119.	6	L13 - L14	
16		FTE OF PART TIME	48.	6	.4 L15	17
17		TOTAL FALL FTE ENROLLMENT	708.	1		
18		RESIDENTS AS PCT HEAD COUNT	79.	4	CHANGE TO 70. IN P6 YEARS	
19		RESIDENT STUDENTS	615.	6	.01 L18 * L13	

INSTRUCTION DATA SHEET

MRI

Name ______________________

Project ______________

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
20		RESIDENT MEN	370.	6	.60 L19	
21		RESIDENT WOMEN	245.	6	L19 - L20	
22		COMMUTING STUDENTS	164.	6	L13 - L19	
23		TUITION FEES PER YEAR	1000.	3	INCREASE 100 PER YEAR	26
24		ROOM-BOARD PER YEAR	800.	3	INCREASE 50 PER YEAR	26
25		BOOKS-SUPPLIES PER YEAR	150.	2	INCREASE 8 PERCENT PER YEAR	26
26		TOTAL STUDENT COSTS / YR	1950.	1		
27		FACULTY				
28		STUDENT-FACULTY RATIO	14.2	4	CHANGE TO 16 IN P3 YEARS	
29		FTE FACULTY-TEACHING	50.	6	L17 / L28	
30		INSTRUCTORS AS PCT FTE	32.	2	INCREASE 0. PERCENT PER YEAR	
31		ASST AS PCT FTE	28.	2	INCREASE 0. PERCENT PER YEAR	
32		ASSOC AS PCT FTE	18.	2	INCREASE 0. PERCENT PER YEAR	
33		PROF AS PCT FTE	22.	2	INCREASE 0. PERCENT PER YEAR	
34		INSTRUCTORS	16.	6	.01 L30 * L29	
35		ASSISTANT PROFESSORS	14.	6	.01 L31 * L29	
36		ASSOCIATE PROFESSORS	9.	6	.01 L32 * L29	
37		FULL PROFESSORS	11.	6	.01 L33 * L29	
38		FTE FACULTY ON SABBATICAL	4.	3	INCREASE .5 PER YEAR	

INSTRUCTION DATA SHEET

MRI

Name

Project

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
39		TOTAL FACULTY-BUDGET	54.	6	L29 + L38	
40		AVG FACULTY SALARY	9400.	4	CHANGE TO 16500 IN P10 YEARS	
41		FRINGES AS PCT SALARY	8.5	4	CHANGE TO 15 IN P10 YEARS	
42		FRINGES IN DOLLARS	800.	6	.01 L41 * L40	
43		AVERAGE FACULTY COMPENSATION	10200.	6	L40 + L42	
44		AVG FACULTY LOAD CREDIT HRS	14.	4	CHANGE TO 10 IN P6 YEARS	
45		AVERAGE CLASS SIZE	15.2	6	L17 / L29 / L44	
46		TOTAL FACULTY COSTS	510800.	6	L39 * L43	48
47		INSTRUCTIONAL SUPPORT	127700.	6	.25 L46	48
48		TOTAL INSTRUCTIONAL COSTS	638500.	1		
49		LIBRARY				
50		VOLUMES ADDED	43000.	6	3 L17	
51		VOLUMES HELD	43000.	9	ACCUM SUM OF LINE 50	
52		PERIODICAL SUBSCRIPTIONS	200.	4	CHANGE TO 500 IN P7 YEARS	
53		BOOK COST PER VOLUME	8.	2	INCREASE 6 PERCENT PER YEAR	
54		PERIODICAL COST/SUBSCRIPTION	14.	2	INCREASE 10 PERCENT PER YEAR	
55		COST OF BOOKS PURCHASED	2124.	6	L50 * L53	58
56		SUBSCRIPTION COSTS	2800.	6	L52 * L54	58
57		ADMINISTRATION AND SERVICE	35790.	6	.75 L51 + 5. L17	58

INSTRUCTION DATA SHEET

MRI

Name ______________________

Project ________________

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
58		LIBRARY EXPENSES	40714.	1		
59		INCOME-EDUC AND GENL				
60		TUITION AND FEES	674000.	6	.96 L23 *L17	64
61		ENDOWMENT	3750.	4	CHANGE TO 100000 IN P10 YEARS	64
62		GIFTS AND GRANTS	112049.	2	INCREASE 10 PERCENT PER YEAR	64
63		OTHER	21311.	2	INCREASE 5 PERCENT PER YEAR	64
64		TOTAL EDUC GENL INCOME	811110.	1		74
65		AUXILIARY ENTERPRISE INCOME				
66		RESIDENCE HALL INCOME	492000.	6	L19 * L24	69
67		BOOKSTORE	106200.	6	L17 * L25	69
68		OTHER	3920.	2	INCREASE 5 PERCENT PER YEAR	69
69		TOTAL AUXILIARY INCOME	602120.	1		74
70		STUDENT AID INCOME				
71		ENDOWED STUDENT AID	53710.	2	INCREASE 10 PERCENT PER YEAR	73
72		SPECIAL GIFTS	29020.	2	INCREASE 15 PERCENT PER YEAR	73
73		TOTAL AID INCOME	83730.	1		74
74		TOTAL CURRENT INCOME	1496960.	1		
75		EXPENSE-EDUC AND GENL				
76		GENERAL ADMINISTRATION	169415.	2	INCREASE 4 PERCENT PER YEAR	83

INSTRUCTION DATA SHEET

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Name ______________________

Project ______________

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
77		STUDENT SERVICES	132800.	2	INCREASE 7 PERCENT PER YEAR	83
78		PUBLIC RELATIONS	97450.	2	INCREASE 6 PERCENT PER YEAR	83
79		GENL INSTITUTIONAL EXPENSE	79385.	2	INCREASE 3 PERCENT PER YEAR	83
80		INSTRUCTION	638500.	6	L48	83
81		LIBRARY	40714.	6	L58	83
82		PLANT OPERTN AND MAINT	187300.	2	INCREASE 5 PERCENT PER YEAR	83
83		TOTAL-EDUC GENL EXPENSE	1345564.	1		90
84		AUXILIARIES				
85		RESIDENCE HALL EXPENSE	442800.	6	.9 L66	88
86		BOOKSTORE	88146.	6	.83 L67	88
87		OTHER	3920.	6	L68	88
88		TOTAL AUXILIARY EXPENSE	534866.	1		90
89		STUDENT FINANCIAL AID EXP	150984.	6	L69 - L88 + L73	90
90		TOTAL CURRENT EXPENSE	2031414.	1		
91		CURRENT OPERATING SURPLUS	-534454.	6	L74 - L90	
92		ACCUMULATED SURPLUS		9	ACCUMULATED SUM OF LINE 91	
93		ANALYSIS				
94		GEN ADMIN AS PCT ED-GEN	12.6	6	L76 / .01 L83	
95		STUDENT SERV AS PCT ED-GEN	9.8	6	L77 / .01 L83	

INSTRUCTION DATA SHEET

MRI

Name ________________

Project ________________

LINE NO.	CHANGE	PLANNING ITEM	BASE LEVEL	CODE	FREEFORM METHOD OF COMPUTATION	SUM
96		PUB REL AS PCT ED-GEN	7.3	6	L78 / .01 L83	
97		GEN INST AS PCT ED-GEN	5.9	6	L79 / .01 L83	
98		INSTRUCT AS PCT ED-GEN	38.5	6	L80/ .01 L83	
99		LIBRARY AS PCT ED-GEN	3.5	6	L81/ .01 L83	
100		PLANT AS PCT ED-GEN	14.2	6	L82/ .01 L83	
101		PCT ED-GEN PAID BY FEES	50.1	6	L60 / .01 L83	
102		FIN AID AS PCT STU FEES	22.6	6	L89 / ,01 L60	
103		FIN AID AS DOLLARS PER STU	213.	6	L89 / L17	
104		GEN ENDOWMENT CORPUS	75000.	6	20. L61	
105		SCHOLARSHIP ENDOW CORPUS	1074200.	6	20. L71	

SUMMARY REPORT DATA SHEET

MRI

Name
Project

TITLE	FREEFORM REPORT LINES	CONTINUE
STUDENT SUMMARY	2, 5, 8, 11-13, 17, 20, 21, 19, 22-26, 28, 101	
FACULTY SUMMARY	34-37, 29, 38-41, 43, 44, 28, 45, 98	
LIBRARY SUMMARY	51, 52, 58, 99	
EDUC AND GENERAL	59-64, 76-83	
AUXILIARIES	65-69, 84-88	
FINANCIAL AID	70-73, 89, 103, 105	
FISCAL SUMMARY	64, 69, 73, 74, 83, 88-92	
SIGNIFICANT FACTORS	2, 13, 17, 23-26, 28, 29, 40, 41, 74, 90, 91, 92, 101, 104,	C
	105	
ANALYSIS SUMMARY	94-105	

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STUDENT SUMMARY          REPORT             SAMPLE COLLEGE            OVERALL MODEL   -  1          CURRENT DATE

    PLANNING ITEM                    1969    1970    1971    1972    1973    1974    1975    1976    1977    1978    1979
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  2 FRESHMEN FALL HEAD COUNT        300.0   315.0   330.0   345.0   360.0   375.0   390.0   405.0   420.0   435.0   450.0
  5 SOPHOMORES FALL HEAD COUNT      180.0   180.0   189.0   198.0   207.0   216.0   225.0   234.0   243.0   252.0   261.0
  8 JUNIORS FALL HEAD COUNT         144.0   144.0   144.0   151.2   158.4   165.6   172.8   180.0   187.2   194.4   201.6
 11 SENIORS FALL HEAD COUNT         130.0   129.6   129.6   129.6   136.1   142.6   149.0   155.5   162.0   168.5   175.0
 12 SPECIAL AND UNCLASSIFIED         25.0    30.0    35.0    40.0    45.0    50.0    55.0    60.0    65.0    70.0    75.0
 13 TOTAL FALL HEAD COUNT             779     798     827     863     906     949     991    1034    1077    1119    1162
 17 TOTAL FALL FTE ENROLLMENT         708     726     753     786     824     863     902     941     980    1019    1057
 20 RESIDENT MEN                    370.0   371.3   377.4   386.1   397.0   407.2   416.6   434.5   452.4   470.3   488.3
 21 RESIDENT WOMEN                  245.0   247.6   251.6   257.4   264.7   271.5   277.7   289.7   301.6   313.6   325.5
 19 RESIDENT STUDENTS               615.0   618.9   629.0   643.5   661.7   678.6   694.3   724.2   754.0   783.9   813.8
 22 COMMUTING STUDENTS              164.0   179.7   198.6   220.3   244.7   270.5   297.6   310.4   323.2   336.0   348.8
 23 TUITION FEES PER YEAR            1000    1100    1200    1300    1400    1500    1600    1700    1800    1900    2000
 24 ROOM-BOARD PER YEAR               800     850     900     950    1000    1050    1100    1150    1200    1250    1300
 25 BOOKS-SUPPLIES PER YEAR         150.0   162.0   175.0   189.0   204.1   220.4   238.0   257.1   277.6   299.9   323.8
 26 TOTAL STUDENT COSTS / YR         1950    2111    2274    2438    2604    2770    2938    3107    3277    3449    3623
 28 STUDENT FACULTY RATIO            14.2    14.8    15.4    16.0    16.0    16.0    16.0    16.0    16.0    16.0    16.0
101 PCT ED-GENL PAID BY FEES         50.1    51.2    54.2    57.3    59.4    61.3    62.9    64.3    65.6    66.7    67.7
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FACULTY SUMMARY          REPORT                  SAMPLE COLLEGE                 OVERALL MODEL   -  1          CURRENT DATE
    PLANNING ITEM                       1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
*************************************************************************************************************************************

  34 INSTRUCTORS                        16.0     15.7     15.6     15.7     16.5     17.3     18.1     18.8     19.6     20.4     21.2
  35 ASSISTANT PROFESSORS               14.0     13.7     13.7     13.8     14.4     15.1     15.8     16.5     17.2     17.8     18.5
  36 ASSOCIATE PROFESSORS                9.0      8.8      8.8      8.8      9.3      9.7     10.2     10.6     11.0     11.5     11.9
  37 FULL PROFESSORS                    11.0     10.8     10.8     10.8     11.3     11.9     12.4     12.9     13.5     14.0     14.5
  29 FTE FACULTY-TEACHING               50.0     49.1     48.9     49.1     51.6     54.0     56.4     58.8     61.3     63.7     66.1
  34 FTE FACULTY ON SABBATICAL           4.0      4.5      5.0      5.5      6.0      6.5      7.0      7.5      8.0      8.5      9.0
  39 TOTAL FACULTY-BUDGET               54.0     53.6     53.9     54.6     57.6     60.5     63.4     66.3     69.3     72.2     75.1
  40 AVG FACULTY SALARY                 9400    10110    10820    11530    12240    12950    13660    14370    15080    15790    16500
  41 FRINGES AS PCT SALARY               8.5      9.1      9.8     10.4     11.1     11.7     12.4     13.0     13.7     14.3     15.0
  43 AVERAGE FACULTY COMPENSATION      10200    11035    11880    12734    13598    14471    15353    16245    17145    18055    18974
  44 AVG FACULTY LOAD CREDIT HRS        14.0     13.3     12.7     12.0     11.3     10.7     10.0     10.0     10.0     10.0     10.0
  24 STUDENT FACULTY RATIO              14.2     14.8     15.4     16.0     16.0     16.0     16.0     16.0     16.0     16.0     16.0
  45 AVERAGE CLASS SIZE                 15.2     16.6     18.2     20.0     21.2     22.5     24.0     24.0     24.0     24.0     24.0
  94 INSTRUC AS PCT ED-GENL             34.5     49.1     50.0     50.6     52.4     53.9     55.2     56.4     57.5     58.5     59.4
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LIBRARY SUMMARY        REPORT              SAMPLE COLLEGE           OVERALL MODEL   -  1         CURRENT DATE

    PLANNING ITEM                   1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
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  51 VOLUMES HELD                  43000    45180    47439    49797    52272    54863    57571    60395    63336    66393    69567
  52 PERIODICAL SUBSCRIPTIONS      200.0    242.9    285.7    328.6    371.4    414.3    457.1    500.0    500.0    500.0    500.0
  58 LIBRARY EXPENSES              40714    59746    64494    69870    75936    82548    89757    97617   104905   112717   121091
  99 LIBRARY AS PCT ED-GENL          3.5      4.0      4.0      4.1      4.1      4.1      4.1      4.1      4.1      4.0      4.0
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EDUC AND GENERAL        REPORT              SAMPLE COLLEGE              OVERALL MODEL   -  1          CURRENT DATE
    PLANNING ITEM                 1969      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
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                                               INCOME EDUC AND GENL
  60 TUITION AND FEES           674000    767422    867589    981000   1108661   1243779   1386354   1536386   1693875   1858821   2031224
  61 ENDOWMENT                    3750     13375     23000     32625     42250     51875     61500     71125     80750     90375    100000
  62 GIFTS AND GRANTS           112049    123253    135579    149137    164050    180456    198501    218351    240186    264205    290626
  63 OTHER                       21311     22376     23495     24670     25903     27198     28558     29986     31486     33060     34713
  64 TOTAL EDUC GEN INCOME      811110    926428   1049664   1187432   1340865   1503309   1674914   1855849   2046298   2246462   2456564
  76 GENERAL ADMINISTRATION     169415    176191    183239    190568    198191    206119    214364    222938    231856    241130    250775
  77 STUDENT SERVICES           132800    142095    152042    162685    174073    186258    199296    213247    228175    244147    261237
  78 PUBLIC RELATIONS            97450    103296    109494    116064    123028    130410    138234    146528    155320    164639    174518
  79 GENL INSTITL EXPENSE        79385     81766     84219     86746     89348     92028     94789     97633    100562    103579    106686
  80 INSTRUCTION                638500    739392    800493    869611    978355   1094117   1217001   1347106   1484534   1629387   1781766
  81 LIBRARY                     40714     59746     64494     69870     75936     82548     89757     97617    104905    112717    121091
  82 PLANT OPERTN AND MAINT     187300    196664    206498    216823    227664    239047    250999    263549    276727    290563    305091
  83 TOTAL EDUC-GENL EXPENSE  13455640   1499155   1600481   1712370   1866597   2030530   2204443   2388622   2582081   2786166   3001168
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AUXILIARIES              REPORT                SAMPLE COLLEGE              OVERALL MODEL   -  1           CURRENT DATE
     PLANNING ITEM                       1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
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                                                 AUXILIARY ENTRSE INCOME
 66 RESIDENCE HALL INCOME               492000   526077   566078   611354   661730   712581   763716   832788   904847   979894  1057929
 67 BOOKSTORE                           106200   117729   131765   148531   168339   190366   214840   242012   272156   305575   342598
 68 OTHER                                 3920     4115     4321     4537     4764     5003     5253     5515     5791     6081     6385
 69 TOTAL AUXILIARY INCOME              602120   647923   702165   764423   834834   907951   983810  1080316  1182796  1291551  1406913

                                                 AUXILIARIES
 85 RESIDENCE HALL EXPENSE              442400   473469   509470   550219   595557   641323   687345   749509   814363   881905   952136
 86 BOOKSTORE                            88146    97715   109365   123280   139721   158004   178317   200870   225890   253627   284356
 87 OTHER                                 3920     4115     4321     4537     4764     5003     5253     5515     5791     6081     6385
 88 TOTAL AUXILIARY EXPENSE             534866   575301   623157   678037   740043   804331   870916   955895  1046044  1141614  1242878
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FINANCIAL AID          REPORT              SAMPLE COLLEGE            OVERALL MODEL   -  1          CURRENT DATE
     PLANNING ITEM                     1969      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
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                                         STUDENT AID INCOME

  71 ENDOWED STUDENT AID              53710     59080     64989     71488     78636     86500     95150    104665    115132    126645    139309
  72 SPECIAL GIFTS                    29020     33372     38378     44135     50756     58369     67125     77193     88772    102088    117402
  73 TOTAL AID INCOME                 83730     92453    103368    115623    129392    144870    162275    181859    203904    228734    256711
  29 STUDENT FINANCIAL AID EXP       150984    165075    182375    202009    224183    243490    275170    306280    340656    378671    420746
 103 FIN AID AS DOLLARS PER STU       213.0     227.1     242.2     257.0     271.8     287.7     304.9     325.3     347.5     371.6     397.7
 105 SCHOLARSHIP ENDOW CORPUS       1074200   1181619   1299781   1429760   1572736   1730009   1903010   2093311   2302643   2532907   2786198
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FISCAL SUMMARY          REPORT                   SAMPLE COLLEGE              OVERALL MODEL   -  1             CURRENT DATE
    PLANNING ITEM                      1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
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 64 TOTAL EDUC GEN INCOME            811110   926428  1049664  1187432  1340865  1503309  1674914  1855849  2046298  2246462  2456564
 69 TOTAL AUXILIARY INCOME           602120   647923   702165   764423   834834   907951   983810  1080316  1182796  1291551  1406913
 73 TOTAL AID INCOME                  83730    92453   103368   115623   129392   144870   162275   181859   203904   228734   256711
 74 TOTAL CURRENT INCOME            1496960  1666805  1855197  2067479  2305093  2556130  2821001  3118026  3432999  3766748  4120189
 83 TOTAL EDUC-GENL EXPENSE        13455640  1499155  1600481  1712370  1866597  2030530  2204443  2388622  2582081  2786166  3001168
 88 TOTAL AUXILIARY EXPENSE          534866   575301   623157   678037   740043   804331   870916   955895  1046044  1141614  1242878
 89 STUDENT FINANCIAL AID EXP        150984   165075   182375   202009   224183   248490   275170   306280   340656   378671   420746
 90 TOTAL CURRENT EXPENSE           2031414  2239532  2406015  2592417  2830825  3083352  3350529  3650798  3968783  4306451  4664793
 91 CURRENT OPERATING SURPLUS       -534454  -572726  -550817  -524937  -525731  -527221  -529528  -532772  -535783  -539703  -544603
 92 ACCUMULATED SURPLUS             -534454 -1107130 -1657998 -2182935 -2708667 -3235889 -3765417 -4298190 -4833973 -5373677 -5918281
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SIGNIFICANT FACTORS     REPORT              SAMPLE COLLEGE            OVERALL MODEL   -  1          CURRENT DATE

     PLANNING ITEM                   1969     1970     1971     1972     1973     1974     1975     1976     1977     1978     1979
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  2 FRESHMEN FALL HEAD COUNT        300.0    315.0    330.0    345.0    360.0    375.0    390.0    405.0    420.0    435.0    450.0
 13 TOTAL FALL HEAD COUNT             779      798      827      863      906      949      991     1034     1077     1119     1162
 17 TOTAL FALL FTE ENROLLMENT         708      726      753      786      824      863      902      941      980     1019     1057
 23 TUITION FEES PER YEAR            1000     1100     1200     1300     1400     1500     1600     1700     1800     1900     2000
 24 ROOM-BOARD PER YEAR               800      850      900      950     1000     1050     1100     1150     1200     1250     1300
 25 BOOKS-SUPPLIES PER YEAR         150.0    162.0    175.0    189.0    204.1    220.4    238.0    257.1    277.6    299.9    323.8
 26 TOTAL STUDENT COSTS / YR         1950     2111     2274     2438     2604     2770     2938     3107     3277     3449     3623
 28 STUDENT FACULTY RATIO            14.2     14.8     15.4     16.0     16.0     16.0     16.0     16.0     16.0     16.0     16.0
 29 FTE FACULTY-TEACHING             50.0     49.1     48.9     49.1     51.6     54.0     56.4     58.8     61.3     63.7     66.1
 40 AVG FACULTY SALARY               9400    10110    10820    11530    12240    12950    13660    14370    15080    15790    16500
 41 FRINGES AS PCT SALARY             8.5      9.1      9.8     10.4     11.1     11.7     12.4     13.0     13.7     14.3     15.0
 74 TOTAL CURRENT INCOME          1496960  1666805  1855197  2067479  2305093  2556130  2821001  3118026  3432999  3766748  4120189
 90 TOTAL CURRENT EXPENSE         2031414  2239532  2406015  2592417  2830825  3083352  3350529  3650798  3968783  4306451  4664793
 91 CURRENT OPERATING SURPLUS     -534454  -572726  -550817  -524937  -525731  -527221  -529529  -532772  -535783  -539703  -544603
 92 ACCUMULATED SURPLUS           -534454 -1107180 -1657998 -2182935 -2708667 -3235889 -3765417 -4298190 -4833973 -5373677 -5918281
101 PCT ED-GENL PAID BY FEES         50.1     51.2     54.2     57.3     59.4     61.3     62.9     64.3     65.6     66.7     67.7
104 GEN ENDOWMENT CORPUS            75000   267500   460000   652500   845000  1037500  1230000  1422500  1615000  1807500  2000000
105 SCHOLARSHIP ENDOW CORPUS      1074200  1181619  1299781  1429760  1572736  1730009  1903010  2093311  2302643  2532907  2786198
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ANALYSIS SUMMARY        REPORT                  SAMPLE COLLEGE               OVERALL MODEL   -  1         CURRENT DATE

    PLANNING ITEM                      1969      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
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  94 GEN ADMIN AS PCT ED-GEN           12.6      11.8      11.4      11.1      10.6      10.2       9.7       9.3       9.0       8.7       8.4
  95 STUD SERV AS PCT ED-GENL           9.8       9.5       9.5       9.5       9.3       9.2       9.0       8.9       8.8       8.8       8.7
  96 PUB REL AS PCT ED-GENL             7.3       6.9       6.8       6.8       6.6       6.4       6.3       6.1       6.0       5.9       5.8
  97 GEN INST AS PCT ED-GENL            5.9       5.5       5.3       5.1       4.8       4.5       4.3       4.1       3.9       3.7       3.6
  98 INSTRUC AS PCT ED-GENL            38.5      49.3      50.0      50.8      52.4      53.9      55.2      56.4      57.5      58.5      59.4
  99 LIBRARY AS PCT ED-GENL             3.5       4.0       4.0       4.1       4.1       4.1       4.1       4.1       4.1       4.0       4.0
 100 PLANT AS PCT ED-GENL              14.2      13.1      12.9      12.7      12.2      11.8      11.4      11.0      10.7      10.4      10.2
 101 PCT ED-GENL PAID BY FEES          50.1      51.2      54.2      57.3      59.4      61.3      62.9      64.3      65.6      66.7      67.7
 102 FIN AID AS PCT STU FEES           22.6      21.5      21.0      20.6      20.2      20.0      19.8      19.9      20.1      20.4      20.7
 103 FIN AID AS DOLLARS PER STU       213.0     227.1     242.2     257.0     271.8     287.7     304.9     325.3     347.5     371.6     397.7
 104 GEN ENDOWMENT CORPUS             75000    267500    460000    652500    845000   1037500   1230000   1422500   1615000   1807500   2000000
 105 SCHOLARSHIP ENDOW CORPUS       1074200   1181619   1299781   1429760   1572736   1730009   1903010   2093311   2302643   2532907   2786198
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ANALYSIS OF PLANNING MATRIX              SAMPLE COLLEGE                                                   CURRENT DATE
                                                  OVERALL MODEL     -   1
.......................................................................................................................
LINE CH            PLANNING ITEM                         BASE    CODE   METHOD OF COMPUTATION                              TOTALS
.......................................................................................................................


  1  -0     STUDENTS


  2  -0             FRESHMEN FALL HEAD COUNT          300.0     3     INCREASE      15.00/YR                                           ADD INTO  13
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                           300.0       315.0       330.0       345.0      360.0       375.0       390.0       405.0       420.0       435.0       450.0

  3  -0             POTENTIAL SOPH                        -0.0     7        0.00X DIAGONAL OF LINE    2                                  ADD INTO  -0
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            -0.0       300.0       315.0       330.0      345.0       360.0       375.0       390.0       405.0       420.0       435.0

  4  -0             PCT RETENTION FR-SOPH                 60.0     2     INCREASE     0.00 PCT PER YR                                    ADD INTO  -0
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            60.0        60.0        60.0        60.0       60.0        60.0        60.0        60.0        60.0        60.0        60.0

  5  -0             SOPHOMORES FALL HEAD COUNT           180.0     6     0.00L    3*     .01L    4     0.00     0      0.00      0   ADD INTO  13
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                           180.0       180.0       189.0       198.0      207.0       216.0       225.0       234.0       243.0       252.0       261.0

  6  -0             POTENTIAL JRS                         -0.0     7        0.00X DIAGONAL OF LINE    5                                  ADD INTO  -0
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            -0.0       180.0       180.0       189.0      198.0       207.0       216.0       225.0       234.0       243.0       252.0

  7  -0             PCT RETENTION SO-JR                   80.0     2     INCREASE     0.00 PCT PER YR                                    ADD INTO  -0
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            80.0        80.0        80.0        80.0       80.0        80.0        80.0        80.0        80.0        80.0        80.0

  8  -0             JUNIORS FALL HEAD COUNT              144.0     6     0.00L    6*     .01L    7     0.00     0      0.00      0   ADD INTO  13
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                           144.0       144.0       144.0       151.2      158.4       165.6       172.8       180.0       187.2       194.4       201.6

  9  -0             POTENTIAL SENIORS                     -0.0     7        0.00X DIAGONAL OF LINE    8                                  ADD INTO  -0
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            -0.0       144.0       144.0       144.0      151.2       158.4       165.6       172.8       180.0       187.2       194.4

 10  -0             PCT RETENTION JR-SR                   90.0     2     INCREASE     0.00 PCT PER YR                                    ADD INTO  -0
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            90.0        90.0        90.0        90.0       90.0        90.0        90.0        90.0        90.0        90.0        90.0

 11  -0             SENIORS FALL HEAD COUNT              130.0     6     0.00L    9*     .01L   10     0.00     0      0.00      0   ADD INTO  13
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                           130.0       129.6       129.6       129.6      136.1       142.6       149.0       155.5       162.0       168.5       175.0

 12  -0             SPECIAL AND UNCLASSIFIED              25.0     3     INCREASE      5.00/YR                                           ADD INTO  13
                            BASE        1970        1971        1972       1973        1974        1975        1976        1977        1978        1979
                            25.0        30.0        35.0        40.0       45.0        50.0        55.0        60.0        65.0        70.0        75.0
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ANALYSIS OF PLANNING MATRIX            SAMPLE COLLEGE                                      CURRENT DATE
                                                OVERALL MODEL     -   1

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LINE CH              PLANNING ITEM                  BASE   CODE   METHOD OF COMPUTATION                           TOTALS
....................................................................................................................


 13  -0              TOTAL FALL HEAD COUNT            779.0    1    TOTAL FROM OTHER LINES                            ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                             779        798        827        863        906        949        991       1034       1077       1119       1162

 14  -0              FULL TIME                        660.0    6     .85L  13     0.00   0     0.00   0     0.00   0   ADD INTO  17
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           660.0      678.8      703.5      734.2      770.5      806.3      843.1      879.3      915.6      951.9      988.2

 15  -0              PART TIME                        119.0    6    0.00L  13-    0.00L  14    0.00   0     0.00   0   ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           119.0      119.8      124.1      129.6      136.0      142.4      148.8      155.2      161.6      168.0      174.4

 16  -0              FTE OF PART TIME                  48.0    6     .40L  15     0.00   0     0.00   0     0.00   0   ADD INTO  17
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                            48.0       47.9       49.7       51.8       54.4       56.9       59.5       62.1       64.6       67.2       69.8

 17  -0              TOTAL FALL FTE ENROLLMENT        708.0    1    TOTAL FROM OTHER LINES                            ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                             708        726        753        786        824        863        902        941        980       1019       1057

 18  -0              RESIDENTS AS PCT HEAD CONT        79.0    4    CHANGE TO     70.00 IN  6 YRS                     ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                            79.0       77.5       76.0       74.5       73.0       71.5       70.0       70.0       70.0       70.0       70.0

 19  -0              RESIDENT STUDENTS                615.0    6     .01L  18*    0.00L  13    0.00   0     0.00   0   ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           615.0      618.9      629.0      643.5      661.7      678.6      694.3      724.2      754.0      783.9      813.8

 20  -0              RESIDENT MEN                     370.0    6     .60L  19     0.00   0     0.00   0     0.00   0   ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           370.0      371.3      377.4      386.1      397.0      407.2      416.6      434.5      452.4      470.3      488.3

 21  -0              RESIDENT WOMEN                   245.0    6    0.00L  19-    0.00L  20    0.00   0     0.00   0   ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           245.0      247.6      251.6      257.4      264.7      271.5      277.7      289.7      301.6      313.6      325.5

 22  -0              COMMUTING STUDENTS               164.0    6    0.00L  13-    0.00L  19    0.00   0     0.00   0   ADD INTO  -0
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           164.0      179.7      198.6      220.3      244.7      270.5      297.6      310.4      323.2      336.0      348.8

 23  -0              TUITION FEES PER YEAR           1000.0    3    INCREASE    100.00/YR                             ADD INTO  26
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                            1000       1100       1200       1300       1400       1500       1600       1700       1800       1900       2000

 24  -0              ROOM-BOARD PER YEAR              800.0    3    INCREASE     50.00/YR                             ADD INTO  26
                            BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                             800        850        900        950       1000       1050       1100       1150       1200       1250       1300
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ANALYSIS OF PLANNING MATRIX          SAMPLE COLLEGE                                        CURRENT DATE
                                              OVERALL MODEL     -   1
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LINE CH            PLANNING ITEM                  BASE   CODE   METHOD OF COMPUTATION                                TOTALS
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 25  -0            BOOKS-SUPPLIES PER YEAR            150.0    2    INCREASE    8.00 PCT PER YR                              ADD INTO  26
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          150.0      162.0      175.0      189.0   204.1      220.4      238.0      257.1      277.6      299.9      323.8

 26  -0            TOTAL STUDENT COSTS / YR            1950    1    TOTAL FROM OTHER LINES                                  ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          1950       2111       2274       2438    2604       2770       2938       3107       3277       3449       3623

 27  -0        FACULTY


 28  -0            STUDENT FACULTY RATIO              14.2     4    CHANGE TO     16.00 IN  3 YRS                            ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          14.2       14.8       15.4       16.0    16.0       16.0       16.0       16.0       16.0       16.0       16.0

 29  -0            FTE FACULTY-TEACHING               50.0     6    0.00L  17/   0.00L  28     0.00     0     0.00     0  ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          50.0       49.1       48.9       49.1    51.6       54.0       56.4       58.8       61.3       63.7       66.1

 30  -0            INSTRUCTORS AS PCT FTE             32.0     2    INCREASE    0.00 PCT PER YR                              ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          32.0       32.0       32.0       32.0    32.0       32.0       32.0       32.0       32.0       32.0       32.0

 31  -0            ASST AS PCT FTE                    28.0     2    INCREASE    0.00 PCT PER YR                              ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          28.0       28.0       28.0       28.0    28.0       28.0       28.0       28.0       28.0       28.0       28.0

 32  -0            ASSOC AS PCT OF FTE                18.0     2    INCREASE    0.00 PCT PER YR                              ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          18.0       18.0       18.0       18.0    18.0       18.0       18.0       18.0       18.0       18.0       18.0

 33  -0            PROF AS PCT FTE                    22.0     2    INCREASE    0.00 PCT PER YR                              ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          22.0       22.0       22.0       22.0    22.0       22.0       22.0       22.0       22.0       22.0       22.0

 34  -0            INSTRUCTORS                        16.0     6    .01L   30*   0.00L  29     0.00     0     0.00     0  ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          16.0       15.7       15.6       15.7    16.5       17.3       18.1       18.8       19.6       20.4       21.2

 35  -0            ASSISTANT PROFESSORS               14.0     6    .01L   31*   0.00L  29     0.00     0     0.00     0  ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          14.0       13.7       13.7       13.8    14.4       15.1       15.8       16.5       17.2       17.8       18.5

 36  -0            ASSOCIATE PROFESSORS                9.0     6    .01L   32*   0.00L  29     0.00     0     0.00     0  ADD INTO  -0
                          BASE       1970       1971       1972    1973       1974       1975       1976       1977       1978       1979
                          9.0        8.8        8.8        8.8     9.3        9.7        10.2       10.6       11.0       11.5       11.9
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ANALYSIS OF PLANNING MATRIX           SAMPLE COLLEGE                                            CURRENT DATE
                                             OVERALL MODEL     -  1
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LINE CH          PLANNING ITEM                    BASE   CODE   METHOD OF COMPUTATION                          TOTALS
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 37  -0          FULL PROFESSORS                  11.0    6      .01L  33*    0.00L  29     0.00   0     0.00    0   ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                      11.0      10.8      10.8      10.8      11.3      11.9      12.4      12.9      13.5      14.0      14.5

 38  -0          FTE FACULTY ON SABBATICAL         4.0    3      INCREASE         .50/YR                               ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                       4.0       4.5       5.0       5.5       6.0       6.5       7.0       7.5       8.0       8.5       9.0

 39  -0          TOTAL FACULTY-BUDGET             54.0    6      0.00L  29*    0.00L  38    0.00   0     0.00    0   ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                      54.0      53.6      53.9      54.6      57.6      60.5      63.4      66.3      69.3      72.2      75.1

 40  -0          AVG FACULTY SALARY               9400    4      CHANGE TO  16500.00 IN 10 YRS                         ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                      9400     10110     10820     11530     12240     12950     13660     14370     15080     15790     16500

 41  -0          FRINGES AS PCT SALARY             8.5    4      CHANGE TO      15.00 IN 10 YRS                        ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                       8.5       9.1       9.3      10.4      11.1      11.7      12.4      13.0      13.7      14.3      15.0

 42  -0          FRINGES IN DOLLARS              800.0    6      .01L  41*    0.00L  40     0.00   0     0.00    0   ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                       800       925      1060      1204      1358      1521      1693      1875      2065      2265      2474

 43  -0          AVERAGE FACULTY COMPENSATION    10200    6      0.00L  40*    0.00L  42    0.00   0     0.00    0   ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                     10200     11035     11880     12734     13598     14471     15353     16245     17145     18055     18974

 44  -0          AVG FACULTY LOAD CREDIT HRS      14.0    4      CHANGE TO      10.00 IN  6 YRS                        ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                      14.0      13.3      12.7      12.0      11.3      10.7      10.0      10.0      10.0      10.0      10.0

 45  -0          AVERAGE CLASS SIZE               15.2    6     15.00L  17/    0.00L  29/   0.00L  44    0.00    0   ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                      15.2      16.6      18.2      20.0      21.2      22.5      24.0      24.0      24.0      24.0      24.0

 46  -0          TOTAL FACULTY COSTS            510800    6      0.00L  39*    0.00L  43    0.00   0     0.00    0   ADD INTO  48
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                    510300    591513    640394    695689    782684    875294    973600   1077684   1187627   1303510   1425413

 47  -0          INSTRUCTIONAL SUPPORT          127700    6      .25L  46     0.00   0      0.00   0     0.00    0   ADD INTO  48
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                    127700    147278    160098    173922    195671    218823    243400    269421    296906    325877    356353

 48  -0          TOTAL INSTRUCTIONAL COSTS      638500    1      TOTAL FROM OTHER LINES                                ADD INTO  -0
                      BASE      1970      1971      1972      1973      1974      1975      1976      1977      1978      1979
                    638500  [illegible]  800493    869611    978355   1094117   1217001   1347106   1484534   1629387   1781766
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ANALYSIS OF PLANNING MATRIX          SAMPLE COLLEGE                                                         CURRENT DATE
                                          OVERALL MODEL      -   1
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LINE CH          PLANNING ITEM                        BASE   CODE   METHOD OF COMPUTATION                                    TOTALS
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 49  -0      LIBRARY


 50  -0            VOLUMES ADDED                       43000     6     3.00L  17      0.00     0      0.00     0      0.00     0   ADD INTO  -0
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                         43000        2180       2259        2358      2474        2591        2707        2824        2940        3057        3173
 51  -0            VOLUMES HELD                        43000     9     ACCUMULATIVE SUM OF LINE  50                                  ADD INTO  -0
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                         43000       45180      47439       49797     52272       54863       57571       60395       63336       66393       69567
 52  -0            PERIODICAL SUBSCRIPTIONS            200.0     4     CHANGE TO     500.00 IN  7 YRS                               ADD INTO  -0
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                         200.0       242.9      285.7       328.6     371.4       414.3       457.1       500.0       500.0       500.0       500.0
 53  -0            BOOK COST PER VOLUME                  8.0     2     INCREASE     6.00 PCT PER YR                                ADD INTO  -0
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                           8.0         8.5        9.0         9.5      10.1        10.7        11.3        12.0        12.8        13.5        14.3
 54  -0            PERIODICAL COST PER SUBSCRPT         14.0     2     INCREASE    10.00 PCT PER YR                                ADD INTO  -0
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                          14.0        15.4       16.9        18.6      20.5        22.5        24.8        27.3        30.0        33.0        36.3
 55  -0            COST OF BOOKS PURCHASED              2124     6     0.00L  50*     0.00L  53      0.00     0      0.00     0   ADD INTO  58
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                          2124       18487      20308       22468     24993       27740       30727       33972       37496       41321       45470
 56  -0            SUBSCRIPTION COSTS                   2800     6     0.00L  52*     0.00L  54      0.00     0      0.00     0   ADD INTO  58
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                          2800        3739       4839        6122      7613        9340       11337       13641       15005       16505       18156
 57  -0            ADMINISTRATION AND SERV             35790     6      .75L  51+     5.00L  17      0.00     0      0.00     0   ADD INTO  58
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                         35790       37518      39345       41278     43328       45466       47691       50003       52403       54890       57465
 58  -0            LIBRARY EXPENSES                    40714     1     TOTAL FROM OTHER LINES                                        ADD INTO  -0
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                         40714       59746      64494       69870     75936       82548       89757       97617      104905      112717      121091
 59  -0      INCOME EDUC AND GENL


 60  -0            TUITION AND FEES                   674000     6      .96L  23*     0.00L  17      0.00     0      0.00     0   ADD INTO  64
                          BASE        1970       1971        1972      1973        1974        1975        1976        1977        1978        1979
                        674000      757422     867589      981000   1108661     1243779     1386354     1536386     1693875     1858821     2031224
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ANALYSIS OF PLANNING MATRIX            SAMPLE COLLEGE                                          CURRENT DATE
                                                 OVERALL MODEL     -   1
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LINE CH             PLANNING ITEM                         BASE   CODE   METHOD OF COMPUTATION                             TOTALS
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 61  -0             ENDOWMENT                           3750     4     CHANGE TO 100000.00 IN 10 YRS                          ADD INTO  64
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           3750      13375      23000      32625      42250      51875      61500      71125      80750      90375     100000

 62  -0             GIFTS AND GRANTS                  112049     2     INCREASE   10.00 PCT PER YR                            ADD INTO  64
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                         112049     123253     135579     149137     164050     180456     198501     218351     240186     264205     290626

 63  -0             OTHER                              21311     2     INCREASE    5.00 PCT PER YR                            ADD INTO  64
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                          21311      22376      23495      24670      25903      27198      28558      29986      31486      33060      34713

 64  -0             TOTAL EDUC GEN INCOME             811110     1     TOTAL FROM OTHER LINES                                     ADD INTO  74
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                         811110     926428    1049664    1187432    1340865    1503309    1674914    1855849    2046298    2246462    2456564

 65  -0         AUXILIARY ENTRSE INCOME


 66  -0             RESIDENCE HALL INCOME             492000     6     0.00L  19*    0.00L  24     0.00     0     0.00     0   ADD INTO  69
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                         492000     526077     566078     611354     661730     712581     763716     832788     904847     979894    1057929

 67  -0             BOOKSTORE                         106200     6     0.00L  17*    0.00L  25     0.00     0     0.00     0   ADD INTO  69
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                         106200     117729     131765     148531     168339     190366     214840     242012     272156     305575     342598

 68  -0             OTHER                               3920     2     INCREASE    5.00 PCT PER YR                            ADD INTO  69
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                           3920       4115       4321       4537       4764       5003       5253       5515       5791       6081       6395

 69  -0             TOTAL AUXILIARY INCOME            602120     1     TOTAL FROM OTHER LINES                                     ADD INTO  74
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                         602120     647923     702165     764423     834834     907951     983810    1080316    1182796    1291551    1406913

 70  -0         STUDENT AID INCOME


 71  -0             ENDOWED STUDENT AID                53710     2     INCREASE   10.00 PCT PER YR                            ADD INTO  73
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                          53710      59080      64989      71488      78636      86500      95150     104665     115132     126645     139309

 72  -0             SPECIAL GIFTS                      29020     2     INCREASE   15.00 PCT PER YR                            ADD INTO  73
                           BASE       1970       1971       1972       1973       1974       1975       1976       1977       1978       1979
                          29020      33372      38378      44135      50756      58369      67125      77193      88772     102088     117402
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ANALYSIS OF PLANNING MATRIX            SAMPLE COLLEGE                                                          CURRENT DATE
                                                OVERALL MODEL      -   1
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LINE CH           PLANNING ITEM                     BASE    CODE   METHOD OF COMPUTATION                                      TOTALS
******************************************************************************************************************************


 73  -0            TOTAL AID INCOME                    83730     1      TOTAL FROM OTHER LINES                                      ADD INTO  74
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                          83730      92453     103362      115623      129392      144870      162275      181859      203904      228734      256711

 74  -0            TOTAL CURRENT INCOME              1496960     1      TOTAL FROM OTHER LINES                                      ADD INTO  -0
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                        1496960    1665805    1855197     2067479     2305093     2556130     2821001     3118026     3432999     3766748     4120189

 75  -0         EXPENSE-EDUCTNL AND GENL


 76  -0            GENERAL ADMINISTRATION             169415     2      INCREASE    4.00 PCT PER YR                             ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                         169415     176191     183239      190568      198191      206119      214364      222938      231856      241130      250775

 77  -0            STUDENT SERVICES                   132800     2      INCREASE    7.00 PCT PER YR                             ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                         132800     142095     152042      162685      174073      186258      199296      213247      228175      244147      261237

 78  -0            PUBLIC RELATIONS                    97450     2      INCREASE    6.00 PCT PER YR                             ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                          97450     103296     109494      116064      123028      130410      138234      146528      155320      164639      174518

 79  -0            GENL INSTITL EXPENSE                79385     2      INCREASE    3.00 PCT PER YR                             ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                          79385      81766      84219       86746       89348       92028       94789       97633      100562      103579      106696

 80  -0            INSTRUCTION                        638500     6       0.00L  48      0.00     0       0.00     0       0.00     0  ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                         638500     739342     800493      869611      978355     1094117     1217001     1347106     1484534     1629387     1781766

 81  -0            LIBRARY                             40714     6       0.00L  58      0.00     0       0.00     0       0.00     0  ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                          40714      59746      64494       69870       75936       82548       89757       97617      104905      112717      121091

 82  -0            PLANT OPERTN AND MAINT             187300     2      INCREASE    5.00 PCT PER YR                             ADD INTO  83
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                         187300     196664     206498      216823      227664      239047      250999      263549      276727      290563      305091

 83  -0            TOTAL EDUC-GENL EXPENSE          13455640     1      TOTAL FROM OTHER LINES                                      ADD INTO  90
                          BASE        1970       1971        1972        1973        1974        1975        1976        1977        1978        1979
                       13455640    1499155    1600481     1712370     1866597     2030530     2204443     2388622     2582091     2786166     3001169

 84  -0         AUXILIARIES
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ANALYSIS OF PLANNING MATRIX          SAMPLE COLLEGE                                                    CURRENT DATE
                                               OVERALL MODEL     -   1
*******************************************************************************************************************
LINE CH             PLANNING ITEM                          BASE    CODE    METHOD OF COMPUTATION                                      TOTALS
*******************************************************************************************************************


 85  -0             RESIDENCE HALL EXPENSE           442800     6       .90L   66       0.00      0        0.00     0       0.00      0    ADD INTO  88
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                       442800      473469      509470      550219      595557      641323      687345      749509      814363      881905      952136

 86  -0             BOOKSTORE                         88146     6       .83L   67       0.00      0        0.00     0       0.00      0    ADD INTO  88
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                        88146       97715      109365      123280      139721      158004      178317      200870      225890      253627      284356

 87  -0             OTHER                              3920     6      0.00L   68       0.00      0        0.00     0       0.00      0    ADD INTO  88
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                         3920        4115        4321        4537        4764        5003        5253        5515        5791        6081        6395

 88  -0             TOTAL AUXILIARY EXPENSE          534866     1       TOTAL FROM OTHER LINES                                           ADD INTO  90
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                       534866      575301      623157      678037      740043      804331      870916      955895     1046044     1141614     1242878

 89  -0             STUDENT FINANCIAL AID EXP        150984     6      0.00L   69-     0.00L   88+      0.00L   73      0.00      0    ADD INTO  90
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                       150984      165075      182375      202009      224183      248490      275170      306280      340656      378671      420746

 90  -0             TOTAL CURRENT EXPENSE           2031414     1       TOTAL FROM OTHER LINES                                           ADD INTO  -0
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                      2031414     2234532     2406015     2592417     2830825     3083352     3350529     3650798     3968783     4306451     4664793

 91  -0             CURRENT OPERATING SURPLUS       -534454     6      0.00L   74-     0.00L   90       0.00     0       0.00      0    ADD INTO  -0
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                      -534454     -572726     -550817     -524937     -525731     -527221     -529529     -532772     -535783     -539703     -544603

 92  -0             ACCUMULATED SURPLUS             -534454     9       ACCUMULATIVE SUM OF LINE  91                                     ADD INTO  -0
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                      -534454    -1107180    -1657998    -2182935    -2708667    -3235889    -3765417    -4298190    -4833973    -5373677    -5918281

 93  -0        ANALYSIS


 94  -0             GEN ADMIN AS PCT ED-GEN            12.6     6      0.00L   76/      .01L   83       0.00     0       0.00      0    ADD INTO  -0
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                         12.6        11.5        11.4        11.1        10.6        10.2         9.7         9.3         9.0         8.7         8.4

 95  -0             STUD SERV AS PCT ED-GENL            9.8     6      0.00L   77/      .01L   83       0.00     0       0.00      0    ADD INTO  -0
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                          9.8         9.5         9.5         9.5         9.3         9.2         9.0         8.9         8.8         8.8         8.7

 96  -0             PUB REL AS PCT ED-GENL              7.3     6      0.00L   78/      .01L   83       0.00     0       0.00      0    ADD INTO  -0
                         BASE        1970        1971        1972        1973        1974        1975        1976        1977        1978        1979
                          7.3         6.9         6.8         6.8         6.6         6.4         6.3         6.1         6.0         5.9         5.8
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ANALYSIS OF PLANNING MATRIX          SAMPLE COLLEGE                                          CURRENT DATE
                                            OVERALL MODEL    -   1
.....................................................................................................................
LINE CH            PLANNING ITEM                       BASE   CODE   METHOD OF COMPUTATION                               TOTALS
.....................................................................................................................


 97  -0            GEN INST AS PCT ED-GENL              5.9     6     0.00L  79/      .01L  83      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                             5.9       5.5       5.3       5.1        4.8       4.5       4.3       4.1       3.9       3.7       3.6

 98  -0            INSTRUC AS PCT ED-GENL              38.5     6     0.00L  80/      .01L  83      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                            38.5      49.3      50.0      50.8       52.4      53.9      55.2      56.4      57.5      58.5      59.4

 99  -0            LIBRARY AS PCT ED-GENL               3.5     6     0.00L  81/      .01L  83      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                             3.5       4.0       4.0       4.1        4.1       4.1       4.1       4.1       4.1       4.0       4.0

100  -0            PLANT AS PCT ED-GENL                14.2     6     0.00L  82/      .01L  83      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                            14.2      13.1      12.9      12.7       12.2      11.9      11.4      11.0      10.7      10.4      10.2

101  -0            PCT ED-GENL PAID BY FEES            50.1     6     0.00L  60/      .01L  83      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                            50.1      51.2      54.2      57.3       59.4      61.3      62.9      64.3      65.6      66.7      67.7

102  -0            FIN AID AS PCT STU FEES             22.6     6     0.00L  89/      .01L  60      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                            22.6      21.5      21.0      20.6       20.2      20.0      19.8      19.9      20.1      20.4      20.7

103  -0            FIN AID AS DOLLARS PER STU         213.0     6     0.00L  89/     0.00L  17      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                           213.0     227.1     242.2     257.0      271.8     287.7     304.9     325.3     347.5     371.6     397.7

104  -0            GEN ENDOWMENT CORPUS               75000     6    20.00L  61       0.00   0      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                           75000    267500    460000    652500     845000   1037500   1230000   1422500   1615000   1807500   2000000

105  -0            SCHOLARSHIP ENDOW CORPUS         1074200     6    20.00L  71       0.00   0      0.00     0      0.00     0   ADD INTO  -0
                            BASE      1970      1971      1972       1973      1974      1975      1976      1977      1978      1979
                         1074200   1181619   1299781   1429760    1572736   1730009   1903010   2093311   2302643   2532907   2786198
```

APPENDIX C

ERROR MESSAGES AND COMMON DATA ERRORS

ERROR MESSAGES AND COMMON DATA ERRORS

The planning system concept permits the planner great flexibility in the development of models. Since the ability to establish relationships between planning items is generalized and almost unlimited, the chance for making errors also exists.

This appendix explains the error messages that the planning system will generate if errors are made. This appendix also identifies common errors and describes the techniques that will correct the errors.

Error Messages

1. "WARNING, WE HAVE GONE THROUGH 100 ITERATIONS AND HAVE BEEN FORCED."

This message appears when the model contains flaws in logic. These flaws usually result in the inability of the system to calculate certain planning item lines. To correct these errors, you should keep in mind that the system cannot generate or project any planning item that depends upon other planning items until all those other planning items have been projected. For example, if Line 7 "Student-Faculty Ratio" depends on Line 18 "Total Students" and Line 22 "Total Faculty," Line 7 cannot be projected until both Line 18 and Line 22 have been projected. Therefore, it may be helpful to look through the Analysis of Planning Matrix (the reports may not contain the critical lines). If a planning item is found with zeros projected across the planning horizon, check the instruction for the generation of that planning item to be certain that the instruction is correct, in the proper format, and that the lines upon which this line depends, if any, are present and correct.

This process of tracing through the relationships of the planning items, both to the lines they are dependent upon and to the lines that depend on them should identify the source of the error. Correct the error and resubmit the job.

2. "THERE IS A ONE LINE COMPARISON ERROR IN LINE ___."

This message occurs when a Code 8 (maximum or minimum of other lines) is used, but only one line is specified. The system will continue as best it can. To correct, examine all planning items that use a Code 8 and identify the one that exhibits only a single line. Insert the other line, or lines, to be examined. Resubmit the run.

3. "LINE ___ HAS BEEN DROPPED. THE NUMBER ASSIGNED TO THE LINE ITEM MUST NOT EXCEED (nnn). PLEASE RENAME."

This message is self-explanatory. It is a reminder that a line number has been encountered that exceeds the upper limit (nnn) for the particular computer being used. The limit of lines is dependent upon the version of the planning system that has been installed on a particular computer. To correct this error, examine the specified line number identified by the message. Either the line must be renumbered, or the model must be reduced to the maximum size permitted. In many cases, this error message is the result of the incorrect placement of the line number in the line number field; that is, if the line number has not been right-adjusted, this error message will be printed, because blanks in the fields are read as zeros. For example, if the line number field, Columns 1-3, contains "85 blank," the line number is read as 850. Changing the field to read "blank 85" would correct this error.

Common Errors

1. Logical loop error: If no obvious errors can be found by examining the individual planning items, search through the chain of dependency of the zero value lines to ensure that there is not a logical loop among the planning items. For example, a condition in which Line 1 depends on Lines 2 and 3; and Line 2 depends on Lines 10, 11, and 12; and Line 12 depends on Line 1 is a logical loop error because it is a logically impossible condition. To correct this error, restructure the model so that the loop is eliminated.

2. Summary error: A difficult error to spot is one involving a Code 1 (summary of other lines). If a line has zero values and is dependent on a Code 1 planning item that has values in the planning horizon, examine the Code 1 planning item to ensure that all specified lines have been totaled. The Code 1 planning item may reflect values in the planning horizon, and still not be completed. The most frequent cause of this error is that a heading line has been specified as being included in the summary line, or that other lines have been summed into a planning item that does not reflect a Code 1. To correct this error, make changes in the planning items to reflect the correct relationship.

3. Generating a planning item reflecting zero values: The planning system has no way of knowing whether a line is completed other than checking whether or not any value in the planning horizon is nonzero (Code 1, "Summary" excepted). Therefore, if you want a particular planning item to appear on the report with zero values for the planning horizon, you must insert a small value (0.0001) in at least one period of the planning

horizon. Various codes could be used, and so long as at least one period contains a nonzero value, the line will be generated, and can be used in other dependent relationships. For example, this technique might be used if you desire a planning item to appear on the report, but there are not any values for the planning item at this time. The 0.0001 value will be printed on the report as a zero because of rounding. The small size of the 0.0001 eliminates its effect when used in dependent relationships with other planning items.

4. A planning item shows only the line number and the planning item name, with no values in the planning matrix: This error is caused by the code field being left blank. The blank causes the system to treat the planning item as a heading. To correct, insert the proper code and resubmit the job.

5. A planning item is not reflected in the planning matrix: This error is often caused by the duplication of the line number. The planning system will accept only one of duplicate line numbers. The other line numbers are disregarded. This problem can often be solved by listing the model input and eliminating duplication of line numbers.

GLOSSARY OF WORDS AND TERMINOLOGY

Accumulative sum	The horizontal summation of the annual values taken on by one planning item in each year of the 10-year planning horizon. Thus, if annual values for a given planning item are: 1, 1, 1, 1, 1, 1, 1, 1, 1, 1; then the accumulative sum is: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
Accumulative product	Similar to accumulative sum described above. Annual values taken on by a given planning item are multiplied horizontally across the 10-year planning horizon. Thus, if annual values are: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; the accumulative product is: 1, 3, 9, 36, 180, 1260, 10080, 90720, 907200. This capability is useful in evaluating such phenomena as growth rate expressed as compound percentage increases.
Base level	The beginning or current level of a given planning item. The numeric value that is assigned to that item now.
Code	The one-character or one-digit symbol assigned to a particular method of projection of a planning item. The code associated with the instruction to project faculty salary by a percentage increase is--2. The computer system keys off these code indications to look for certain indicators in the following verbiage.
Constant value	A value that remains fixed throughout the time span of the planning horizon. Constant values are often used as multiplying factors in equations, i.e., Code 6 projections. Constant values may also be projected across the planning horizon as bounding values, for example.
Delimiter	In writing an instruction for a projection--a portion of the instruction is "freeform." To compensate for that lack of structure, some character must be used to separate the several parts of the instruction. For example, Code 5--the insertion of data--requires that the individual data points be separated by commas. These commas serve to delimit the fields--thus they are called delimiters.

Exercising the model	The processing of the model in computer runs. The examination of model results under various and varied alternative assumptions.
Field	A data processing term. A field is a collection of one or more contiguous characters usually in a machine sensible form and considered as one data item. Example--the Planning Item field is the collection of alphabetic, numeric, and special characters (including blanks) between card columns 5 and 32 of an instruction.
Freeform method of computation	This portion of the instruction is called freeform because the system accommodates a variety of verbiage describing how the item is to be projected. This information is unformated; that is, the model builder is not restricted to certain columns for data entry.
Input	Data, information, and instructions put into a format assembled in an appropriate fashion to be applied to the computer for processing.
Line number	A nonsymbolic number assigned to a planning item for ease in identification and internal manipulation. The line number concept is analogous to the budget line numbers.
Model	In the HELP/PLANTRAN system, a collection of planning items, identified with a verbal description as well as a unique line number and each with an associated instruction for projection of values through time. The model is a vehicle or analytic tool that aids in the prediction of how an institution or organization would react or perform under a given, hypothesized set of conditions.
Output	The product or result of a computer run usually in the form of a pre-designated report or tabulation.
Planning horizon	That period of time of interest to the planner. Ten years seems to be a common period of interest in long-range planning, although many institutions characteristically use a shorter period and for some purposes a longer period may be necessary.

PLANTRAN	An acronym for PLANning TRANslator. An English-like language in which a planner may instruct the computer to perform calculations in order to project values of a given planning item through time.
Printout	The physical product of a computer run. A tabulation. See Output above.
Reserved character	Within the rules of the PLANTRAN language, certain characters in the "freeform method of computation" have special meaning and cause the computer to perform special calculations. Since the computer cannot perceive the context in which these characters are used, they are reserved and are not to be used except as defined in the rules of the language. See Chapter IV for a discussion of these rules.
Right adjusted	To place the rightmost character of a data item in the rightmost position in the field designated for that item. No space is left in that field following the information entered.
System driver	The facility within the HELP/PLANTRAN system to automatically step through a series of pre-designated iterations or runs examining several sets of hypotheses at one time. This capability permits the design of experiments to examine multiple alternatives simultaneously.
Variable	One planning item. Mathematically the planning items or variables are considered to be a matrix of row vectors that are either auto-generated or are functions of other row vectors. The description of a planning item along with its 10 projected values is considered to be one variable.